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B.B.

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"Population and Habitat Assessment Methods"
MONTANA STATE UNIVERSITY
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Fish Resources within the Tenderfoot Experimental Forest Montana: 1991-95

Final Report to:
USDA, Forest Service, Rocky Mountain Research Station
316 East Myrtle Street
Boise, Idaho 83702

Contract: INT-92682-RJVA
(Part 1)

1997

Montana Cooperative Fishery
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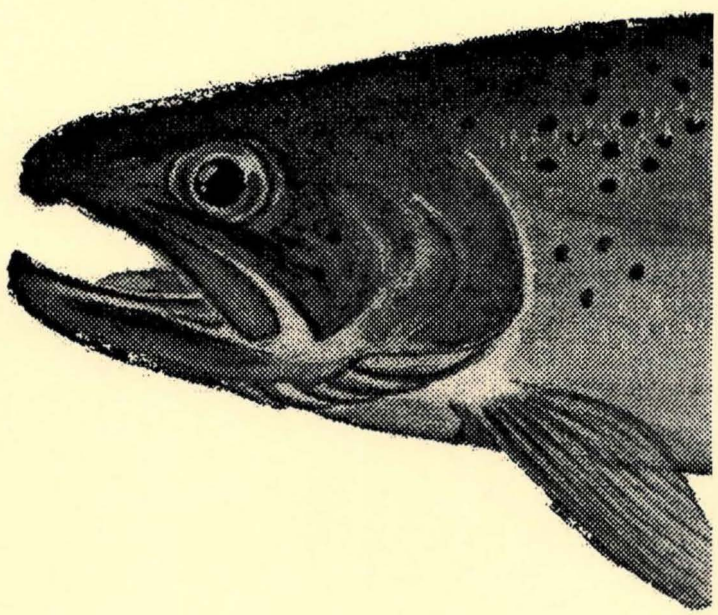

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Fish Resources within the Tenderfoot Experimental Forest Montana: 1991-95

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EXECUTIVE SUMMARY

The Montana Cooperative Fishery Research Unit at Montana State University was contracted by the USDA Forest Service's Intermountain Research Station (contract INT-RJVA-92682) to collect baseline fish resource information for Tenderfoot Creek and its tributaries within the Tenderfoot Creek Experimental Forest (TCEF). These data were collected from 1992 to 1995. The westslope cutthroat trout population inhabiting the upper Tenderfoot Creek drainage (within the TCEF) consists of a hybrid swarm of westslope cutthroat and rainbow trout. These Oncorhynchus spp. are distributed downstream from Spring Park Creek. They make up a progressively larger component of the fish community down to the lower boundary of the Experimental Forest, where they comprised 35-50% of the salmonid community. Brook trout were the only fish species found in the upper portion of the Tenderfoot Creek drainage above Spring Park Creek where channel gradient was relatively low (about 3% compared to over 5% for the channel down to the TCEF boundary). The estimated biomass of Oncorhynchus spp. ranged from 0.11 to 4.75 g/m^2 where they were present and the estimated biomass of brook trout ranged from 0.33 to 6.23 g/m^2. Mottled sculpins inhabit the lower portion of Tenderfoot Creek up to a falls located about 0.2 km below Pack Creek that was identified as a barrier to upstream fish movement. None of the tributaries to Tenderfoot Creek within the Experimental Forest, except Sun Creek, support fish populations. Sun Creek supports only brook trout. Cascade/riffle habitat types were dominant in Tenderfoot Creek. Pools comprised a very small proportion (< 3%) of the stream channel. We found few Oncorhynchus spp. young-of-the-year that suggests very limited recruitment. We observed numerous young-of-the-year brook trout, suggesting their recruitment may be relatively high.

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INTRODUCTION

The Tenderfoot Creek Experimental Forest (TCEF) was established in 1961 to investigate effects of timber harvest on water yield and quality in a subalpine forest of the Northern Rockies draining east of the Continental Divide (Farnes et al. 1995; Figure 1). Prior to 1991 the only management activity within the TCEF was the construction of an access road to install stream measurement flumes (Farnes et al. 1995). These flumes were not installed until 1992 and 1993 (Farnes et al. 1995). The Montana Cooperative Fishery Research Unit was contracted by the USDA Intermountain Research Station (INT-RJVA-92682) to estimate annual survival rates, population size, age composition, and fecundity for fish populations in Tenderfoot Creek on the Tenderfoot Experimental Forest. We previously published two papers, "Age at sexual maturity, sex ratio, fecundity, and longevity of isolated headwater populations of westslope cutthroat trout" (Downs et al. 1997) and "Factors influencing retention of visible implant tags by westslope cutthroat trout inhabiting headwater streams of Montana" (Shepard et al. 1996). These journal articles summarized some of the data collected from Tenderfoot and numerous other streams. We do not repeat those findings in this report. Staff from the Rocky Mountain Research Station in Boise, Idaho collected fish habitat information in 1991. This report summarizes fish population and fish habitat information collected from 1991 to 1995. Copies of field data and data summaries are archived at the USDA Forestry Sciences Laboratory at Montana State University, the Rocky Mountain Research Station at Boise, Idaho, and Montana Department of Fish, Wildlife and Parks in dBase format. A detailed explanation of each field is presented in Appendix A.

STUDY AREA

Farnes et al. (1995) described the history, vegetation, geology, and climate of the TCEF and presented information on stream flows, climate, and water quality parameters measured from 1992 through 1994. USGS stream gauge information for the Smith River at Logan, Montana, the nearest flow gauge station with more than 15 years of record, was used to document flow conditions from 1991 to 1995 (Figure 2). These flow data indicate that summer flows (July through September) were below average in 1991, 1992, and 1994; near average in 1995; and the highest on record in 1993. Peak flows were below average in all years except 1994. Mean annual flows were above average in 1993, near average in 1995, and below average during other years.

Westslope cutthroat trout (Oncorhynchus clarki lewisi), rainbow trout (Oncorhynchus mykiss), hybrids between westslope and rainbow and cutthroat trout, brook trout (Salvelinus fontinalis), and mottled sculpins (Cottus bairdi) are all present within the TCEF. A sample of ten fish taken from main Tenderfoot Creek immediately below the mouth of Stringer Creek on August 21, 1992 were all hybrids between westslope cutthroat trout and rainbow trout based on horizontal starch gel electrophoresis (Dr. R. Leary, Salmon and Trout Genetics Laboratory, Division of Biological Sciences, University of Montana, Missoula, letter of May 16, 1995). All fish identified in the field as westslope cutthroat trout, rainbow trout, or hybrids between these two species were designated as Oncorhynchus spp. Using external morphologic characteristics we believed that Oncorhynchus

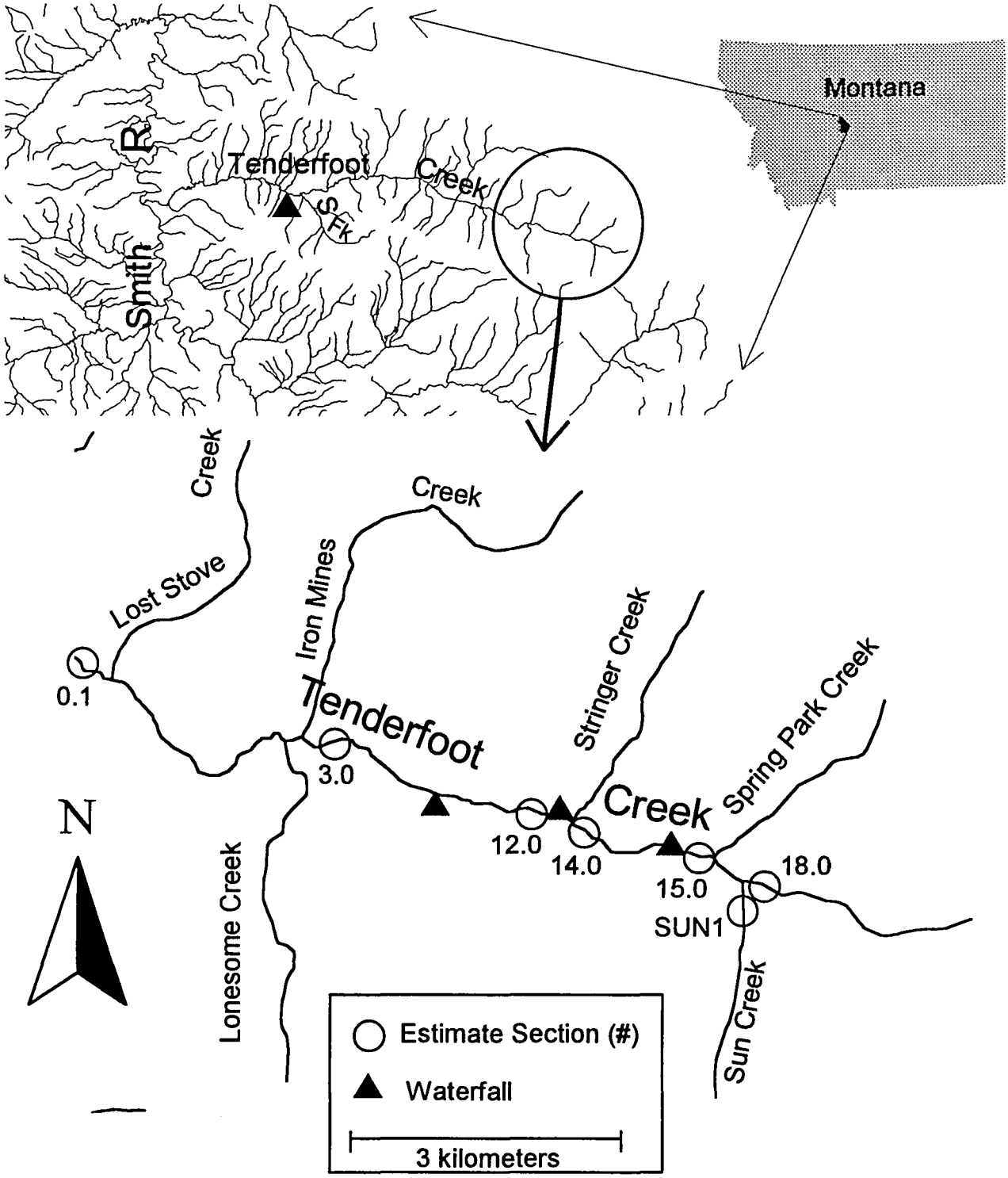

Figure 1. Map of upper Tenderfoot Creek showing sampling sections (○) where fish population estimates were conducted from 1992 to 1995 and locations of waterfalls (▲) which were believed to be barriers to fish movement upstream.

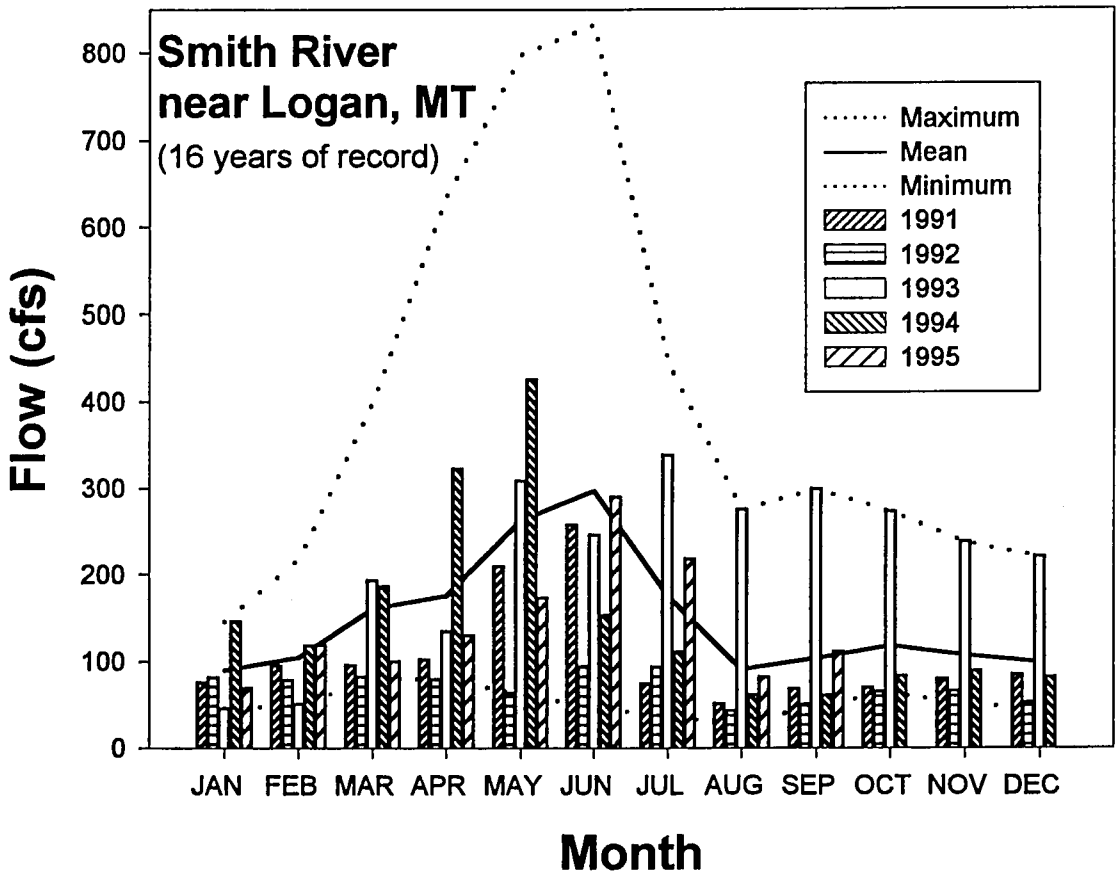

Figure 2. Mean, minimum, and maximum monthly flows recorded by the USGS in the Smith River at Logan, Montana from 1977 to 1995 and for the years 1991 through 1995. The 1995 data is provisional.

spp. inhabiting the upper portion of the drainage, above Stringer Creek, were mostly rainbow trout, while those closer to the lower boundary of the TCEF appeared to be more like westslope cutthroat trout.

Hatchery raised rainbow trout, undesignated cutthroat trout, and brook trout were released into Tenderfoot Creek from 1934 to 1954 (Table 1). Hanzel (1959) reported that rainbow trout were first released into Tenderfoot Creek above an approximately 9 m waterfall located about 1.5 km below the South Fork Tenderfoot Creek (T14N;R04E;Sec25; upper part of Figure 1), about 20 km below the TCEF, in 1955. In 1958 Hanzel found what he considered pure westslope cutthroat trout from about 3.5 km above this falls upstream, but in the 3.5 km above the falls he found westslope cutthroat trout, rainbow trout, and hybrids.

Table 1. Releases of hatchery fish (RB = rainbow trout; CT = undesignated cutthroat trout; EBT = brook trout) into the Tenderfoot Creek drainage based on a query of the Montana Department of Fish, Wildlife and Parks fish stocking database.

Date	Species	Number	Average length (mm)
08/28/34	EBT	8,260	102
10/13/38	CT	26,200	fry
09/22/39	CT	34,200	fry
10/18/40	CT	30,000	fry
09/18/41	CT	25,000	fry
09/15/48	CT	9,600	51
	RB	1,280	152
09/17/48	CT	25,000	fry
09/06/51	CT	45,000	25
08/25/54	CT	54,840	25

METHODS

Fish Sampling

Fish were captured using a Smith-Root BP-15 backpack electrofisher. This electrofisher has a variable voltage pulsator with current supplied by a gas-powered generator. We initially attempted to limit our output to straight D.C., however, due to the limited power capability of the generator (300 watts), the unit was ineffective at capturing fish using straight D.C. We subsequently used pulsed output with voltages in the range of 100 to 600 volts and frequencies under 50 Hz to maximize the number of fish captured while minimizing injury to the fish caused by the shock (W. Fredenberg, U.S.D.I. Fish and Wildlife Service, Creston, Montana; personal communication). To estimate populations two or more electrofishing passes were made. Fish captured during each pass were held in netted buckets within the stream during each successive pass. Fish were sampled from 1992 through 1995 (Table 2).

Fish populations were monitored in six sample sections of Tenderfoot Creek (Sections 3, 12, 14, 15, and 18) and one section of Sun Creek (SUN1) within the TCEF from 1992 to 1995 (Figure 1). A fish population estimate was made in another section of Tenderfoot Creek (Section 0.1) below the TCEF boundary, about 0.5 km below the mouth of Lost Stove Creek, in 1994. Single-pass electrofishing surveys were conducted in numerous other sections of Tenderfoot, Spring Park, Stringer, and Bubbling creeks to document fish distribution, relative abundance, and seasonal movements.

In 1993 high summer flows prevented us from making population estimates in the lower three estimate sections of Tenderfoot Creek due to unsafe sampling conditions. A single electrofishing pass was made in at least one sample section of all tributaries we suspected might contain fish in 1992 and 1993. During October 1993 single electrofishing pass surveys were conducted in fourteen sample sections in main Tenderfoot Creek, from the Experimental Forest boundary upstream to just below Stringer Creek, to document relative fish abundance throughout the stream and to assess seasonal movements of Oncorhynchus spp.

All captured fish were weighed to the nearest gram and fork lengths (FL) were measured to the nearest millimeter. All Oncorhynchus spp. (westslope cutthroat trout, rainbow trout, and their hybrids) over 120 mm (FL) were tagged with visible implant (VI) tags according to methods of Haw et al. (1990) and recommendations from the manufacturer (Northwest Marine Technology, Shaw Island, Washington, personal communication). Twenty-nine, 56, and 77 fish were tagged during 1992, 1993, and 1994, respectively. Eleven Oncorhynchus spp. between 85 and 120 mm had their left pelvic fins removed during 1992 sampling. Ten Oncorhynchus spp. were angled from Tenderfoot Creek below the mouth of Stringer Creek for genetic analysis in 1992. Otoliths were removed from these 10 fish for age determination (Downs 1995).

Table 2. Sample sections in the Tenderfoot Creek drainage showing sample dates, stream kilometer section length (m), wetted width (m), estimator (1=1-pass, 2-4=multiple pass depletion, I=above water observation, P=mark-recapture Peterson), water and air temperature (F), conductivity (umhos), pH, and number of seconds electrofished by pass. Seconds per pass were not recorded in 1992.

STREAM Section	Date	Stream km	Section length	Wetted width	Estimator	Temperature Water	Temperature Air	Conductivity (umho)	pH	Seconds by pass 1	Seconds by pass 2	Seconds by pass 3
BUBBLING SPRING CREEK												
1.0	08/20/92	0.10	100.0	0.8	I	-	-	-	-	0	0	0
1.0	08/24/94	0.05	120.0	0.8	1	54.6	81.0	66.0	8.8	509	0	0
SPRING PARK CREEK												
1.0	08/20/92	0.10	50.0	0.5	1	53.0	-	109.0	8.8	0	0	0
1.0	08/31/93	0.10	48.0	1.0	1	-	-	-	-	436	0	0
STRINGER CREEK												
1.0	08/19/92	0.20	78.0	2.6	1	45.6	-	103.0	8.3	0	0	0
2.0	09/01/93	1.30	67.0	1.0	1	39.0	49.0	-	-	764	0	0
SUN CREEK												
1.0	08/19/92	0.20	91.5	1.1	3	56.7	-	82.3	7.8	0	0	0
1.0	08/31/93	0.20	98.0	1.4	2	41.0	46.0	-	-	2435	2307	0
1.0	08/22/94	0.20	102.0	1.0	4	50.7	60.0	76.0	8.6	1272	1352	1310
1.0	08/21/95	0.20	102.0	1.0	2	55.5	75.3	62.2	8.8	1425	944	0
TENDERFOOT CREEK												
0.1	09/16/94	32.00	132.2	4.8	2	52.0	78.0	-	-	2039	1419	0
0.2	09/16/94	32.60	103.0	5.5	1	47.0	64.0	-	-	1368	0	0
1.0	10/13/93	35.36	7.0	3.0	1	37.0	50.0	-	-	103	0	0
2.0	10/13/93	35.30	24.0	3.0	1	37.0	50.0	-	-	681	0	0
3.0	08/18/92	35.40	175.0	4.2	2	47.8	-	113.0	8.5	0	0	0
3.0	10/13/93	35.40	175.0	5.0	1	37.0	50.0	-	-	3209	0	0
3.0	08/24/94	35.40	175.0	4.0	2	52.4	78.2	96.0	8.6	3410	2209	0
3.0	08/22/95	35.40	175.0	6.0	2	50.5	71.0	78.2	8.6	2345	1809	0
4.0	10/13/93	35.50	15.0	3.0	1	37.0	50.0	-	-	220	0	0
5.0	10/13/93	35.52	15.0	3.0	1	37.0	50.0	-	-	203	0	0
6.0	10/13/93	35.80	12.0	3.0	1	37.0	50.0	-	-	130	0	0
7.0	10/13/93	36.10	12.0	3.0	1	37.0	50.0	-	-	421	0	0
8.0	10/13/93	36.80	15.0	3.0	1	37.0	50.0	-	-	153	0	0
9.0	10/13/93	36.90	20.0	3.0	1	37.0	50.0	-	-	454	0	0
10.0	10/13/93	37.80	5.0	3.0	1	37.0	50.0	-	-	281	0	0
11.0	10/13/93	37.90	14.0	3.0	1	37.0	50.0	-	-	395	0	0
12.0	08/22/95	38.20	133.0	6.0	3	52.2	77.2	80.0	8.7	2199	1786	1580

Table 2. (continued).

STREAM Section	Date	Stream km	Section length	Wetted width	Estimator	Temperature Water	Temperature Air	Conductivity (umho)	pH	Seconds by pass 1	Seconds by pass 2	Seconds by pass 3
TENDERFOOT CREEK (continued)												
12.0	08/18/92	38.20	133.0	5.0	2	47.8	-	113.0	8.5	0	0	0
12.0	10/12/93	38.20	133.0	5.0	1	37.0	41.0	-	-	1841	0	0
12.0	08/23/94	38.20	133.0	3.5	2	52.7	-	102.0	8.8	2554	2073	0
13.0	10/12/93	38.40	140.0	5.0	1	37.0	50.0	-	-	2020	0	0
14.0	08/19/92	38.50	177.0	2.7	2	47.2	-	109.0	8.6	0	0	0
14.0	09/01/93	38.50	100.0	5.0	1	-	-	-	-	1282	0	0
14.0	10/12/93	38.50	177.0	5.0	1	37.0	41.0	-	-	3203	0	0
14.0	08/23/94	38.50	177.0	4.0	2	51.4	-	98.0	8.5	2721	2004	0
14.0	08/22/95	38.50	177.0	6.0	2	55.6	84.7	84.0	8.3	2699	2158	0
15.0	08/20/92	40.10	174.0	3.2	2	52.8	-	115.0	8.8	0	0	0
15.0	08/30/93	40.10	174.0	3.4	2	39.0	42.0	-	-	3365	2783	0
15.0	08/23/94	40.10	174.0	3.0	2	45.5	54.8	108.0	8.8	2598	1963	0
15.0	08/21/95	40.10	174.0	3.0	2	51.3	84.0	114.0	8.9	2299	1384	0
16.0	09/01/93	40.30	115.0	3.0	1	40.0	44.0	-	-	1471	0	0
17.0	09/01/93	40.40	70.0	3.0	1	40.0	44.0	-	-	1495	0	0
18.0	08/20/92	40.90	80.0	1.4	2	49.5	-	191.0	9.0	0	0	0
18.0	08/31/93	40.90	87.0	1.6	4	38.0	46.0	-	-	1887	1332	1290
18.0	08/22/94	40.90	87.0	1.0	2	53.2	60.0	192.0	8.5	1265	825	0
18.0	08/22/95	40.90	87.0	1.0	2	55.0	70.0	152.0	8.6	1138	878	0

Ages were assigned using length frequency plots of fish captured within each estimate section and ages interpreted from scale and otolith samples (Downs 1995). Estimated numbers of fish in 75 to 149 mm and 150 mm and longer length classes were apportioned to age classes and population estimates were calculated by age. Unfortunately, we were unable to make population estimates for Oncorhynchus spp. during 1993 due to high flows in the lower reaches of Tenderfoot Creek, which was the only area they occurred. This precluded us from making survival estimates for Oncorhynchus spp. between any years but 1994 and 1995.

Habitat

Habitat availability and condition was assessed in two reaches of Tenderfoot Creek by Intermountain Research Station personnel during October 1991 using the Intermountain Station's habitat survey methodology (Overton et al. in prep.). The first reach extended from Iron Mines Creek upstream to Stringer Creek. The second reach extended from Stringer Creek upstream to Onion Park.

Five streambed core samples were removed from a pool tail area, identified as probable spawning habitat, immediately below Lost Stove Creek on September 15, 1994 using a hollow core sampler modified from a design described by McNeil and Ahnell (1964). Personnel from the Forest Service's Hydrology Laboratory in Helena, Montana oven dried the samples, sieved, and recorded the weights of material passing through each sieve.

Data Analysis

Average fish lengths (FL) were calculated for each section. Total fish lengths measured in 1992 were converted to fork lengths by dividing by Carlander's (1969) conversion value of 1.05. Relative fish abundance was calculated as the catch of fish in one electrofishing pass standardized to 100 m of stream length. Multiple-pass fish population estimates were calculated using a maximum likelihood estimator within the MICROFISH population estimation software (Van Deventer and Platts 1986). Population estimates were also standardized as the number of fish per 100 m of stream length. Biomass of Oncorhynchus spp. and brook trout were estimated using population estimates and average weights by 75 to 149 mm and 150 + mm size classes. Neither populations nor biomass of fish less than 75 mm were estimated, however, relative abundance (number captured per 100 m of stream length sampled) were calculated.

The relative weight (in grams) of Oncorhynchus spp. 75 mm (FL) and longer in the Tenderfoot Creek drainage was compared to the relative weight of 11,407 Oncorhynchus spp. 75 mm and longer captured in 16 drainages within the upper Missouri River and upper Clark Fork drainages from 1992 to 1995 using methods of Wege and Anderson (1978) as described by Anderson and Gutreuter (1983). We regressed log(weight) against log(length) for the entire 11,407 sample data set and for 278 fish captured in the Tenderfoot Creek drainage and compared regression slopes and elevations according to methods presented by Zar (1974).

Gowan et al. (1994) suggested that to effectively assess the magnitude of fish movement, several different techniques should be used. We marked all Oncorhynchus spp. longer than 110 mm captured in about 1 kilometer of sampled stream (20% of the total available in the TCEF). Sampling a relatively large proportion of available habitats across the range of occupied habitats increased our probability of detecting movement of fish. We also estimated the proportion of "new" fish (those not previously captured and marked) captured in sections sampled over time which, along with our estimates of capture efficiencies, provided another relative measure of the amount of movement which occurred.

Habitat data were summarized using the FBASE computer program developed by the Intermountain Station (C. Overton, USDA Intermountain Research Station, personal communication). For hollow core samples, we averaged the proportion of material, by weight, which passed through each sieve and plotted the cumulative distribution by size class.

RESULTS

Fish Abundance and Distribution

Oncorhynchus spp. were only captured below Spring Park Creek and their relative abundance increased in a downstream direction to the lower boundary of the TCEF (Table 3 and Figure 3, left column). Brook trout were the only fish species present in Tenderfoot Creek above Spring Park Creek (sample sections 16-18) and in Sun Creek (Table 3 and Figures 3, right column). Mottled sculpins were abundant in lower Tenderfoot Creek within the TCEF, but were not found above an approximately 2-m waterfall located about 1.5 km below Stringer Creek.

One Oncorhynchus spp. was captured in Bubbling Spring Creek on August 24, 1994 in a pool created by the installation of a water measurement flume in 1993. No fish were observed or captured in lower Bubbling Spring Creek during an electrofishing survey in 1992. We suspect that this constructed pool was the only habitat suitable for holding fish in Bubbling Creek. No fish were captured in Spring Park, Stringer, or Pack creeks. Visual surveys of Passionate and Lonesome creeks indicated they were not large enough to support fish.

Estimates of both Oncorhynchus spp. and brook trout were relatively consistent between years within sections (Figure 4 and Table 3). The estimated biomass of Oncorhynchus spp. ranged from 0.11 to 4.75 g/m^2 where they were present (Appendix B). The estimated biomass of brook trout ranged from 0.33 to 6.23 g/m^2 (Appendix B). Total estimated biomass of salmonids ranged from 0.83 to 6.90 g/m^2.

Oncorhynchus spp. less than 75 mm were only captured in sample sections immediately above and below the TCEF boundary (Sections 0.1, 0.2 and 3.0) and catches were low in these sections

Table 3. Dates fish surveys were made in each sample section showing estimator (1 = 1-pass; 2-4 = depletion estimator with number of passes; A = angling; and I = visual observation), length of section (m), and catches in one electrofishing pass, estimated populations, and mean lengths of Oncorhynchus spp. and brook trout by length group.

STREAM Section / Date	Section length (Estimator)	Oncorhynchus spp. Number captured on 1st Pass <75 mm	75-149 mm	150+ mm	Oncorhynchus spp. Estimated number (SE) 75-149 mm	150 + mm	Oncorhynchus spp. Mean length	Brook trout Number captured on 1st Pass <75 mm	75-149 mm	150+ mm	Brook trout Estimated number (SE) 75-149 mm	150 + mm	Brook trout Mean length
BUBBLING SPRING													
1.0													
8/20/92	100.0 (I)	No fish observed											
8/24/94	120.0 (1)	0	0	1	0 (0)	0 (0)	187.0	0	0	0	0 (0)	0 (0)	-
SPRING PARK CREEK													
1.0													
8/20/92	50.3 (1)	No fish captured											
8/31/93	48.0 (1)	No fish captured											
STRINGER CREEK													
1.0													
8/19/92	77.7 (1)	No fish captured											
2.0													
9/ 1/93	67.0 (1)	No fish captured											

Table 3. (Continued).

STREAM Section / Date	Section length (Estimator)	Oncorhynchus spp. Number captured on 1st Pass <75 mm	75-149 mm	150+ mm	Estimated number (SE) 75-149 mm	150 + mm	Mean length	Brook trout Number captured on 1st Pass <75 mm	75-149 mm	150+ mm	Estimated number (SE) 75-149 mm	150 + mm	Mean length
SUN CREEK													
1.0													
8/19/92													
	91.0	0	0	0	0	0	-	2	16	3	30	3	106.4
	(3)				(0)	(0)					(3)	(0)	
8/31/93													
	98.0	0	0	0	0	0	-	7	22	4	40	5	106.9
	(2)				(0)	(0)					(8)	(1)	
8/22/94													
	102.0	0	0	0	0	0	-	1	26	1	55	1	104.6
	(4)				(0)	(0)					(4)	(0)	
8/21/95													
	102.0	0	0	0	0	0	-	7	24	4	29	5	110.3
	(2)				(0)	(0)					(1)	(1)	
TENDERFOOT CREEK													
0.1													
9/16/94													
	132.2	2	21	33	28	34	153.2	8	9	10	10	11	136.2
	(2)				(2)	(0)					(0)	(0)	
0.2													
9/16/94													
	103.0	1	13	23	0	0	162.8	0	7	0	0	0	132.9
	(1)				(0)	(0)					(0)	(0)	
1.0													
10/13/93													
	7.0	0	0	0	0	0	-	0	0	1	0	0	223.0
	(1)				(0)	(0)					(0)	(0)	

Table 3. (Continued).

STREAM Section / Date	Section length (Estimator)	Oncorhynchus spp. Number captured on 1st Pass <75 mm	75-149 mm	150+ mm	Estimated number (SE) 75-149 mm	150 + mm	Mean length	Brook trout Number captured on 1st Pass <75 mm	75-149 mm	150+ mm	Estimated number (SE) 75-149 mm	150 + mm	Mean length
TENDERFOOT CREEK (continued)													
2.0													
10/13/93	24.0 (1)	0	1	4	0 (0)	0 (0)	194.8	0	1	3	0 (0)	0 (0)	159.0
3.0													
8/18/92	175.3 (2)	1	7	14	12 (3)	15 (0)	155.1	2	10	20	13 (1)	23 (1)	156.5
10/13/93	175.0 (1)	0	2	24	0 (0)	0 (0)	205.8	0	8	19	0 (0)	0 (0)	162.3
8/24/94	175.0 (2)	0	7	11	9 (1)	15 (1)	161.7	6	15	20	23 (3)	22 (1)	146.1
8/22/95	175.0 (2)	1	3	18	2 (0)	9 (0)	181.5	8	10	24	13 (1)	27 (1)	141.4
4.0													
10/13/93	15.0 (1)	0	0	2	0 (0)	0 (0)	235.0	0	0	0	0 (0)	0 (0)	-
5.0													
10/13/93	15.0 (1)	0	1	1	0 (0)	0 (0)	139.0	0	0	0	0 (0)	0 (0)	-

Table 3. (Continued).

STREAM Section / Date	Section length (Estimator)	Oncorhynchus spp. Number captured on 1st Pass <75 mm	75-149 mm	150+ mm	Estimated number (SE) 75-149 mm	150 + mm	Mean length	Brook trout Number captured on 1st Pass <75 mm	75-149 mm	150+ mm	Estimated number (SE) 75-149 mm	150 + mm	Mean length
TENDERFOOT CREEK (continued)													
6.0													
10/13/93	12.0 (1)	0	0	1	0 (0)	0 (0)	154.0	0	0	0	0 (0)	0 (0)	-
7.0													
10/13/93	12.0 (1)	0	0	1	0 (0)	0 (0)	211.0	0	0	5	0 (0)	0 (0)	183.4
8.0													
10/13/93	15.0 (1)	No fish captured											
9.0													
10/13/93	20.0 (1)	No fish captured											
10.0													
10/13/93	5.0 (1)	0	0	5	0 (0)	0 (0)	206.4	0	0	1	0 (0)	0 (0)	173.0
11.0													
10/13/93	14.0 (1)	0	1	4	0 (0)	0 (0)	183.0	0	1	2	0 (0)	0 (0)	172.7

Table 3. (Continued).

STREAM Section / Date	Section length (Estimator)	Oncorhynchus spp. Number captured on 1st Pass <75 mm	75-149 mm	150+ mm	Estimated number (SE) 75-149 mm	150 + mm	Mean length	Brook trout Number captured on 1st Pass <75 mm	75-149 mm	150+ mm	Estimated number (SE) 75-149 mm	150 + mm	Mean length
TENDERFOOT CREEK (continued)													
12.0													
8/18/92													
	133.0	0	3	5	4	5	173.1	0	2	15	2	19	184.1
	(2)				(1)	(0)					(0)	(1)	
10/13/93													
	133.0	0	1	2	0	0	182.7	0	8	6	0	0	143.6
	(1)				(0)	(0)					(0)	(0)	
8/23/94													
	133.0	0	1	5	1	6	184.6	0	8	14	13	14	154.4
	(2)				(0)	(1)					(3)	(0)	
8/22/95													
	133.0	0	0	3	0	3	190.3	6	5	14	11	18	126.4
	(3)				(0)	(0)					(2)	(1)	
13.0													
8/21/92													
	15.0	0	0	10	0	0	205.0	0	0	0	0	0	-
	(A)				(0)	(0)					(0)	(0)	
10/12/93													
	140.0	0	1	7	0	0	192.1	0	6	7	0	0	148.4
	(1)				(0)	(0)					(0)	(0)	

Table 3. (Continued).

STREAM Section / Date	Section length (Estimator)	Oncorhynchus spp. Number captured on 1st Pass <75 mm	75-149 mm	150+ mm	Estimated number (SE) 75-149 mm	150 + mm	Mean length	Brook trout Number captured on 1st Pass <75 mm	75-149 mm	150+ mm	Estimated number (SE) 75-149 mm	150 + mm	Mean length
TENDERFOOT CREEK (continued)													
14.0													
8/19/92													
	177.0	0	0	4	0	5	198.0	0	5	26	5	28	179.4
	(2)				(0)	(1)					(0)	(0)	
10/12/93													
	177.0	0	0	2	0	0	209.5	0	4	2	0	0	129.5
	(1)				(0)	(0)					(0)	(0)	
8/23/94													
	177.0	0	0	4	1	4	186.4	4	6	16	6	17	154.0
	(2)				(0)	(0)					(0)	(0)	
8/22/95													
	177.0	0	0	3	1	3	187.8	0	17	8	21	9	127.5
	(2)				(0)	(0)					(1)	(0)	
15.0													
8/20/92													
	174.0	0	1	5	2	5	172.2	0	3	2	5	2	136.0
	(2)				(1)	(0)					(1)	(0)	
8/30/93													
	174.0	0	0	1	0	2	151.3	0	0	4	0	6	155.6
	(2)				(0)	(1)					(0)	(1)	
8/23/94													
	174.0	0	0	3	0	3	173.7	3	4	8	4	9	147.4
	(2)				(0)	(0)					(0)	(0)	
8/21/95													
	174.0	0	0	1	0	1	180.0	0	3	9	4	9	169.3
	(2)				(0)	(0)					(1)	(0)	
16.0													
9/ 1/93													
	115.0	0	0	0	0	0	-	1	7	7	0	0	137.5
	(1)				(0)	(0)					(0)	(0)	

Table 3. (Continued).

STREAM Section / Date	Section length (Estimator)	Oncorhynchus spp. Number captured on 1st Pass <75 mm	75-149 mm	150+ mm	Oncorhynchus spp. Estimated number (SE) 75-149 mm	150 + mm	Oncorhynchus spp. Mean length	Brook trout Number captured on 1st Pass <75 mm	75-149 mm	150+ mm	Brook trout Estimated number (SE) 75-149 mm	150 + mm	Brook trout Mean length
TENDERFOOT CREEK (continued)													
17.0													
9/ 1/93													
	70.0	0	0	0	0	0	-	3	6	6	0	0	131.7
	(1)				(0)	(0)					(0)	(0)	
18.0													
8/20/92													
	79.0	0	0	0	0	0	-	2	41	3	53	3	101.8
	(2)				(0)	(0)					(3)	(0)	
8/31/93													
	87.0	0	0	0	0	0	-	1	17	10	42	13	123.3
	(4)				(0)	(0)					(3)	(0)	
8/22/94													
	87.0	0	0	0	0	0	-	4	30	6	40	6	110.8
	(2)				(0)	(0)					(3)	(0)	
8/22/95													
	87.0	0	0	0	0	0	-	9	32	5	37	8	101.1
	(2)				(0)	(0)					(1)	(1)	

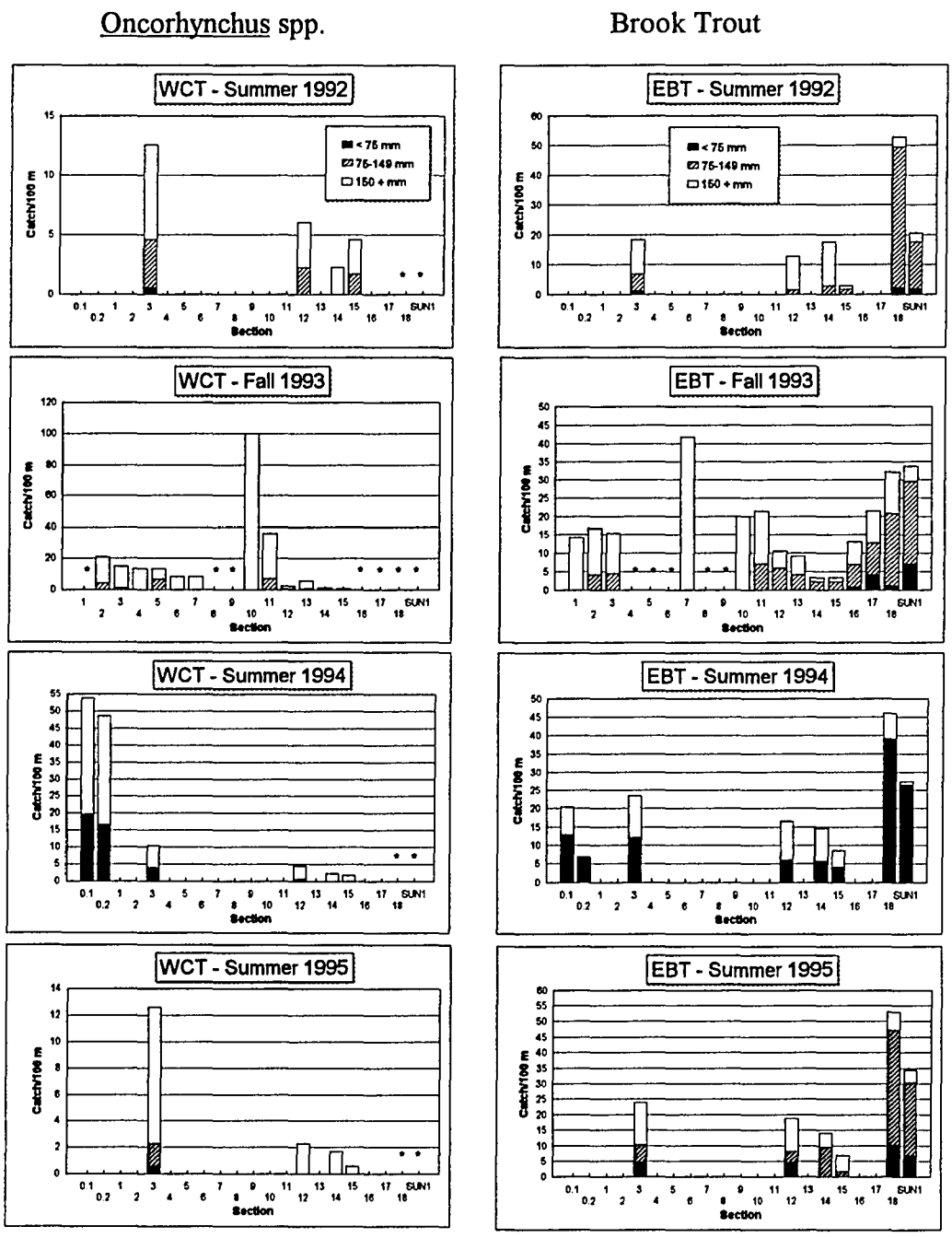

Figure 3. Relative catch (number captured in one electrofishing pass per 100 m of stream length) of Oncorhynchus spp. (WCT; left) and brook trout (EBT; right) for two length groups in sample sections located within the Tenderfoot Creek drainage (SUN = Sun Creek) from 1992 to 1995. Asterisks (*) indicate no fish captured in section. During fall 1993 sampling Sections 7 and 10 each represent a single pool habitat.

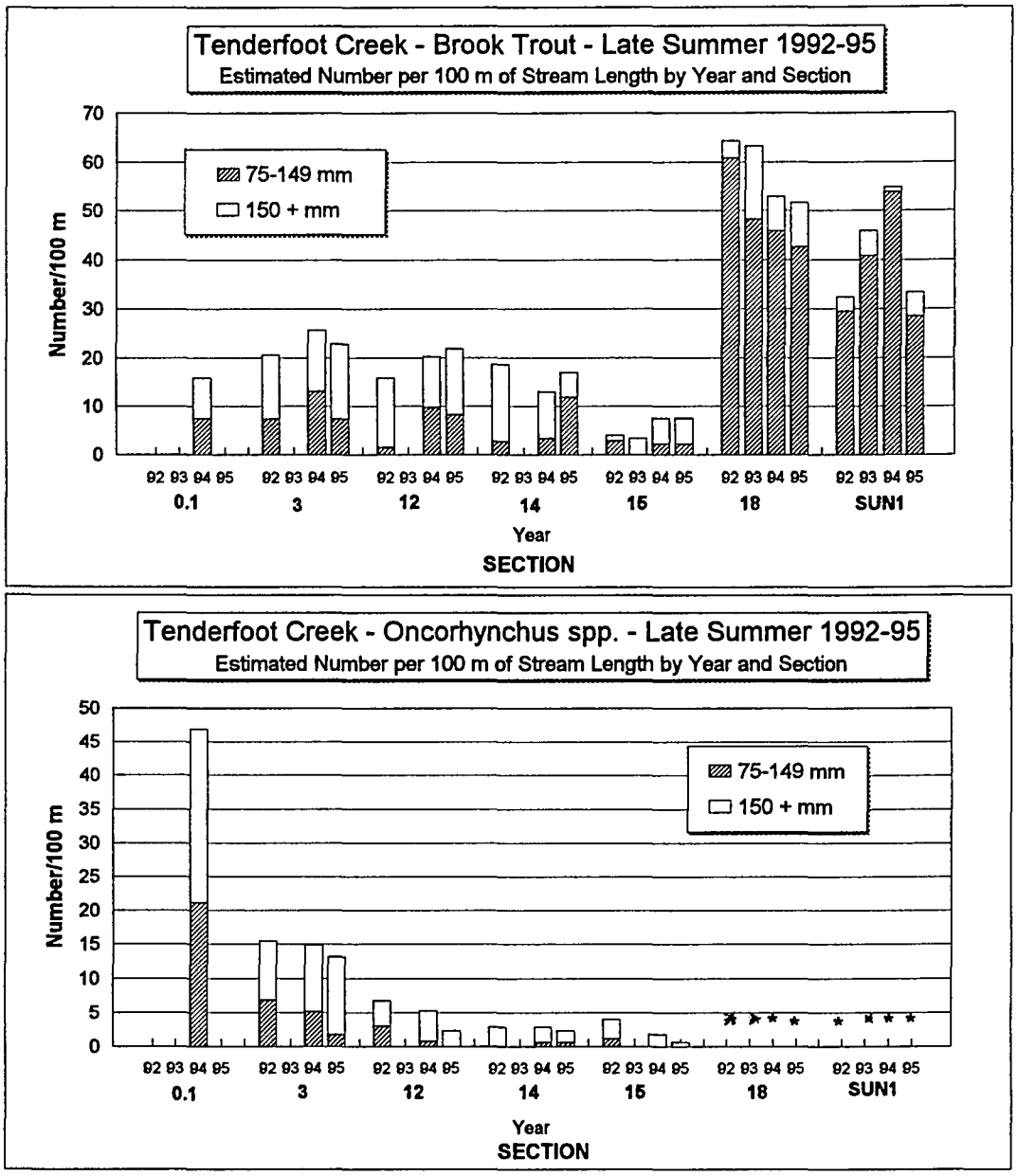

Figure 4. Estimated number of brook trout (top) and Oncorhynchus spp. (bottom) 75 mm and longer (FL) per 100 m of stream length in sample sections (SUN = Sun Creek) located within the Tenderfoot Creek drainage from 1992 to 1995. Asterisks (*) indicate no fish captured.

(Figure 3, left column). Brook trout less than 75 mm were captured in most sample sections, but highest catches occurred in upper sections (Figure 3, right column). Temporal variation in catches of brook trout less than 75 mm were also observed with higher catches obtained in Section 3 in 1994 and 1995, in Section 12 in 1995, in Sections 14 and 15 in 1994, in Section 18 in 1994 and 1995, and in Sun Creek in 1993 and 1995.

Fish Movement

Only 10 of 162-tagged Oncorhynchus spp. were subsequently recaptured, with one fish recaptured twice (Table 4). Only one recaptured fish had moved from the section where it was originally tagged, moving 100 m upstream (Tag "Y AA2", Table 4). Two of 11 fin clipped fish were subsequently recaptured. Both of these were recaptured within sections where fish were originally fin clipped.

Our estimated efficiencies of capture in depletion estimate sections ranged from 0.60 to 1.00. The proportion of "new" fish subsequently captured in those sections where sampling was repeated ranged from 0.33 to 1.00 (Table 5). This result suggests that either more movement was occurring than was indicated by tag recovery data, capture efficiencies were overestimated, or a combination of these two factors.

Length Frequency, Age, and Growth

Length frequency plots for Oncorhynchus spp. captured during the summers of 1992 through 1995 indicated that few fish under 90 mm were captured (Figure 5). Ages interpreted from otoliths removed from Oncorhynchus spp. captured in Tenderfoot Creek immediately below Stringer Creek were age 3 for fish 150 and 160 mm (FL); age 4 for fish 181, 191, 206, and 210 mm; age 5 for a fish 198 mm, and age 7 for a fish 271 mm (C. Downs, Montana State University, personal communication). Downs (1995) also found that Oncorhynchus spp. age 1 averaged 119 mm (range: 114-124), age 2 averaged 153 mm (range: 113-178), age 3 averaged 187 mm (range: 128-216), and age 4+ averaged 226 mm (range: 200-258) based on scale sample aging and lengths at capture. Downs also found that many Oncorhynchus spp., especially westslope cutthroat trout that emerge later, did not form a first year annulus on their scales, making accurate aging extremely difficult.

We assumed that fish 120 to 170 mm were probably age 2, fish 90 to 120 mm were probably age 1, and fish less than 90 mm were probably age 0. Applying that assumption to the length frequency plots suggests that the 1991 and 1993 year classes were relatively "strong", based on the abundance of age 1 fish (90-120 mm) in 1992 and 1994, while the 1990 and 1994 year classes were "weak". Age 2 fish were relatively abundant in 1994, despite a relatively "weak" catch of age 1 fish in 1993. Growth of Oncorhynchus spp. which had been tagged and subsequently recaptured indicated that fish 140 to 200 mm when tagged grew from 16 to 40 mm a year, while fish tagged at lengths over 200 grew at much slower annual rates (Table 4). Oncorhynchus spp. under 150 mm (age 2 and younger) grew approximately 50 mm per year based on distance

Table 4. Tag recaptures of Oncorhynchus spp. tagged and recaptured in Tenderfoot Creek from 1992 through 1993. Tagging length for 1992 is reported as fork length (FL) which was converted from total length (TL) by the equation FL=TL/1.05.

STREAM Tag Number	Date	Length	Growth	Stream km	Distance moved (km)
TENDERFOOT CK					
Y AA2	08/18/92	161		38.20	
First Recapture	10/12/93	201	40	38.30	0.10
Y AB5	08/18/92	201		35.40	
First Recapture	08/24/94	247	36	35.40	0.00
BKTE2	10/12/93	175		38.20	
First Recapture	08/23/94	207	32	38.20	0.00
BKTF7	10/13/93	218		35.40	
First Recapture	08/24/94	227	9	35.40	0.00
BKTF2	10/13/93	211		35.40	
First Recapture	08/24/94	222	11	35.40	0.00
Second Recapture	08/22/95	225	3	35.40	0.00
WHKK2	08/23/94	184		38.20	
First Recapture	08/22/95	201	17	38.20	0.00
WHKF6	08/23/94	180		38.20	
First Recapture	08/22/95	196	16	38.20	0.00
WHKK5	08/24/94	167		35.40	
First Recapture	08/22/95	185	18	35.40	0.00
WHKK6	08/24/94	151		35.40	
First Recapture	08/22/95	180	29	35.40	0.00
WHKL2	08/24/94	147		35.40	
First Recapture	08/22/95	182	35	35.40	0.00

Table 5. Number of Oncorhynchus spp. 75 mm and longer captured, tagged or fin clipped (marked), and marked fish subsequently recaptured by sample section and date along with capture efficiencies estimated using a maximum likelihood multiple pass estimator and calculated proportion of "new" fish captured.

Section	Date	Captured	Marked	Recaptured	Proportion "new"	Estimated efficiency
3.0	08/18/92	25	18	0	-	0.84
	10/13/93	26	24	1	0.96	-
	08/24/94	25	15	3	0.88	0.75
	08/22/95	23	0	4	0.83	0.92
	Average				0.89	0.84
12.0	08/18/92	9	9	0	-	0.90
	10/12/93	3	2	1	0.66	-
	08/23/94	7	6	1	0.86	0.88
	08/22/95	3	0	2	0.33	1.00
	Average				0.62	0.93
14.0	08/19/92	5	5	0	-	0.83
	10/12/93	2	1	1	0.50	-
	08/23/94	5	4	0	1.00	0.83
	08/22/95	4	0	0	1.00	0.80
	Average				0.83	0.82
15.0	08/20/92	7	6	0	-	0.86
	08/30/93	3	3	0	1.00	0.60
	08/23/94	3	2	1	0.66	1.00
	08/21/95	1	0	0	1.00	1.00
	Average				0.89	0.87

between nodes of length frequency plots (Figure 5). Length frequency plots for brook trout indicated that age 0, 1, 2, and 3 and older brook trout ranged in length from approximately 20 to 50 mm, 60 to 110 mm, 120 to 140 mm, and 150 mm and longer, respectively (Figure 5).

Relative weight regressions indicated that the 278 Oncorhynchus spp. captured in the Tenderfoot Creek drainage had slightly higher weights relative to lengths than all 11,407 Oncorhynchus spp. captured in 18 drainages of the upper Missouri and Clark Fork river drainages during 1992 to 1995 (Figure 6). Regression slopes were not significantly different ($0.50 P < 0.20$), but regression elevations were significantly different ($P < 0.05$) between these two log(length)-log(weight) relationships.

Survival Estimates

Our estimates of annual survival across sample sections for Oncorhynchus spp. between 1994 and 1995 were extremely variable, but averaged 35% from age 1 to age 2, 84% from age 2 to age 3, and 51% for fish age 3 and older (Table 6). Estimates of annual survival for brook trout from age 1 to age 2 were much more consistent across both sample sections and years with average annual survival estimated to be from 89 to 100%. Estimated annual survival rates for brook trout age 2 and older were somewhat more variable with annual survivals ranging from 19 to 69% from 1992 to 1995. The movement of Oncorhynchus spp. into and out of sample sections between years, as reported in the "Movement" section, complicates any interpretation of survival estimates derived from annual population estimates.

Habitat Quantity and Condition

Pool habitats in Tenderfoot Creek made up less than 3% of the stream's length between Iron Mines Creek and Stringer Creek, and about 5% between Stringer Creek and Onion Park (Appendix C). Mean depths were 22 and 13 cm and mean widths were 4.0 and 2.2 m in the two sections, respectively. Mean residual pool volumes were 9.9 and 11.0 cubic meters in the two sections, respectively. Woody debris was moderately abundant in both sections, averaging 5.0 and 4.3 pieces per 100 m, respectively. Almost all (> 99%) of the streambanks were stable in both sections with relatively little of the streambanks being undercut (< 5%). We located three barriers to upstream fish movement in Tenderfoot Creek within the TCEF: 1) an approximately 2 m waterfall located about 1.5 km below Stringer Creek; 2) an approximately 3 m waterfall located just below the mouth of Stringer Creek; 3) and a series of waterfalls located about 150 m below the mouth of Spring Park Creek. Hollow core sampling of the streambed below Lost Stove Creek in 1995 showed that about 25% of the streambed material was made up of particles less than 6.3 mm (Figure 7).

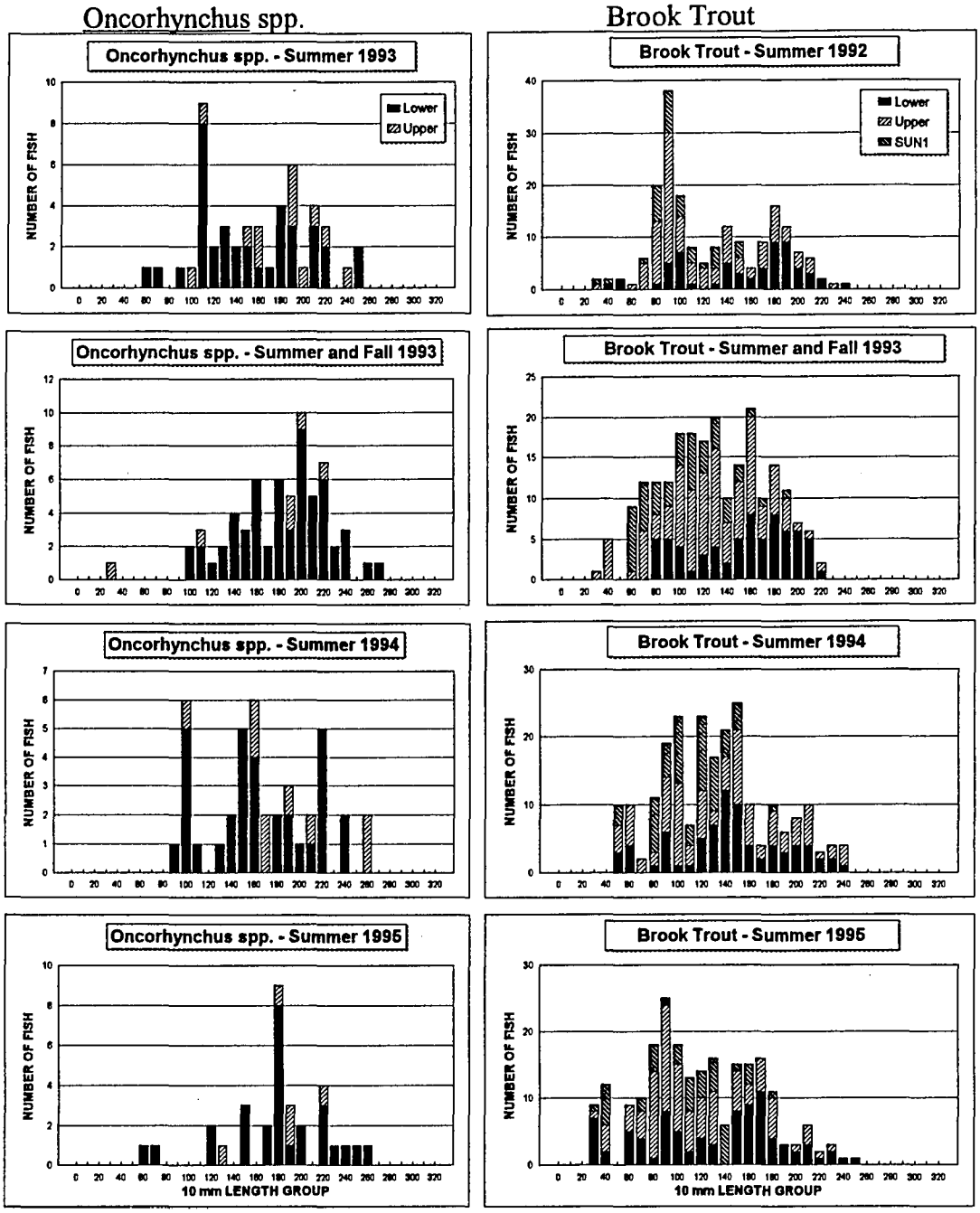

Figure 5. Length frequency plots of Oncorhynchus spp. (left) and brook trout (right) captured during the summers of 1992 through 1995 in the upper Tenderfoot Creek drainage by year. "Lower" indicates sections 0.1 to 13 (below falls at Stringer Creek), "Upper" indicates sections 14 to 18, and "SUN1" indicates Sun Creek.

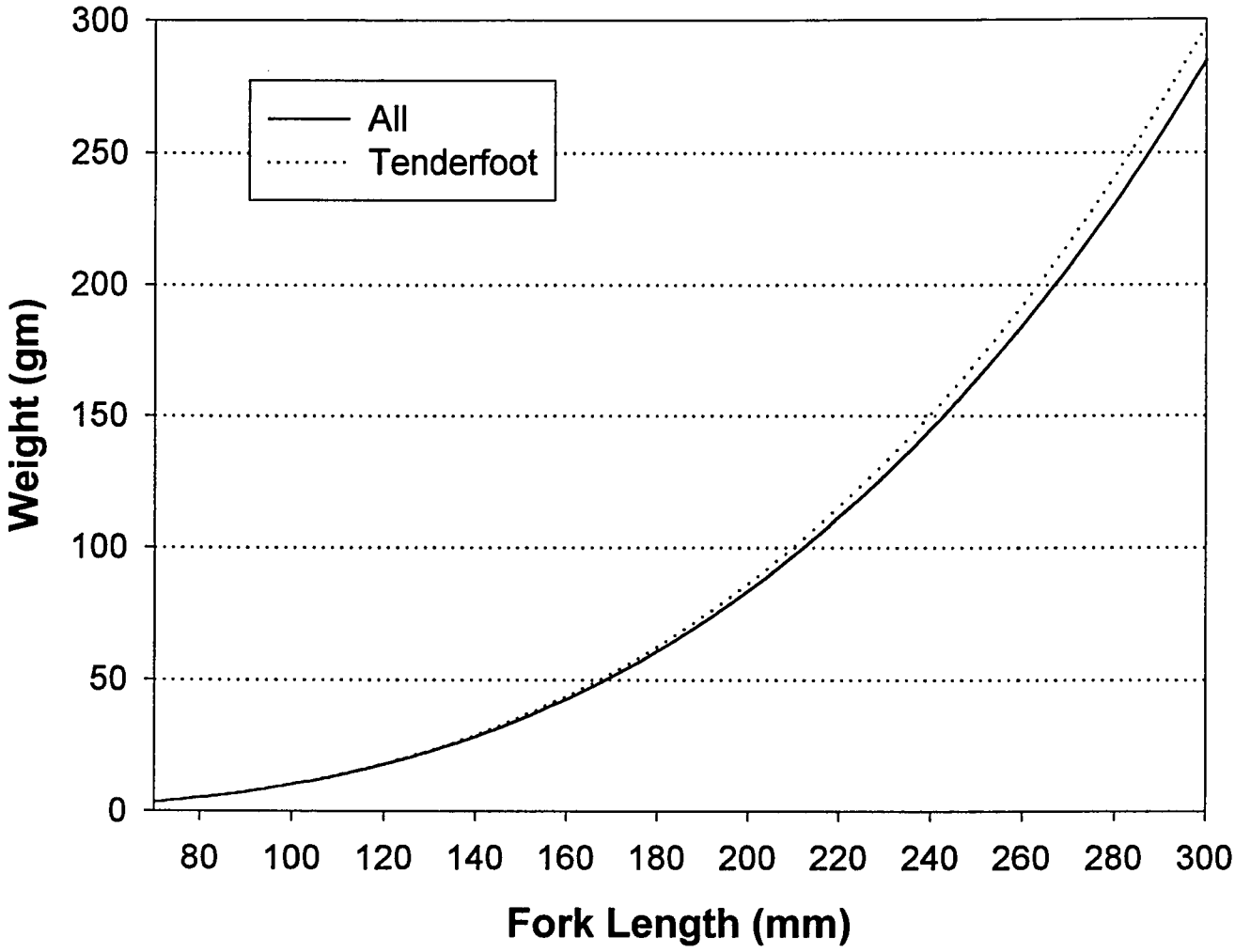

Figure 6. Log(length) to log(weight) regression lines for 11,407 Oncorhynchus spp. 75 mm and longer captured in 16 drainages in Montana ("All") and for 278 Oncorhynchus spp. 75 mm and longer captured in the Tenderfoot Creek drainage (Tenderfoot) from 1992 to 1995.

Table 6. Estimated survival rates for Oncorhynchus spp. and brook trout by section, age class, and year in Tenderfoot and Sun creeks from 1992 to 1995.

Species		Section						
Age Classes	Years	3	12	14	15	18	Sun1	Average
Oncorhynchus spp.								
Age 1 to 2	94 to 95	0.70	0.00	N/A	N/A	-	-	0.35
Age 2 to 3	94 to 95	0.87	0.97	1.00	0.50	-	-	0.84
Age 3 +	94 to 95	0.96	0.40	0.66	0.00	-	-	0.51
Brook trout								
Age 1 to 2	92 to 93	-	-	-	-	0.79	1.00	0.90
	93 to 94	-	-	-	-	1.00	1.00	1.00
	94 to 95	0.90	1.00	1.00	0.75	0.85	0.84	0.89
Age 2 +	92 to 93	-	-	-	-	1.00	0.37	0.69
	93 to 94	-	-	-	-	0.35	0.03	0.19
	94 to 95	0.70	0.73	0.35	0.89	0.15	0.12	0.49

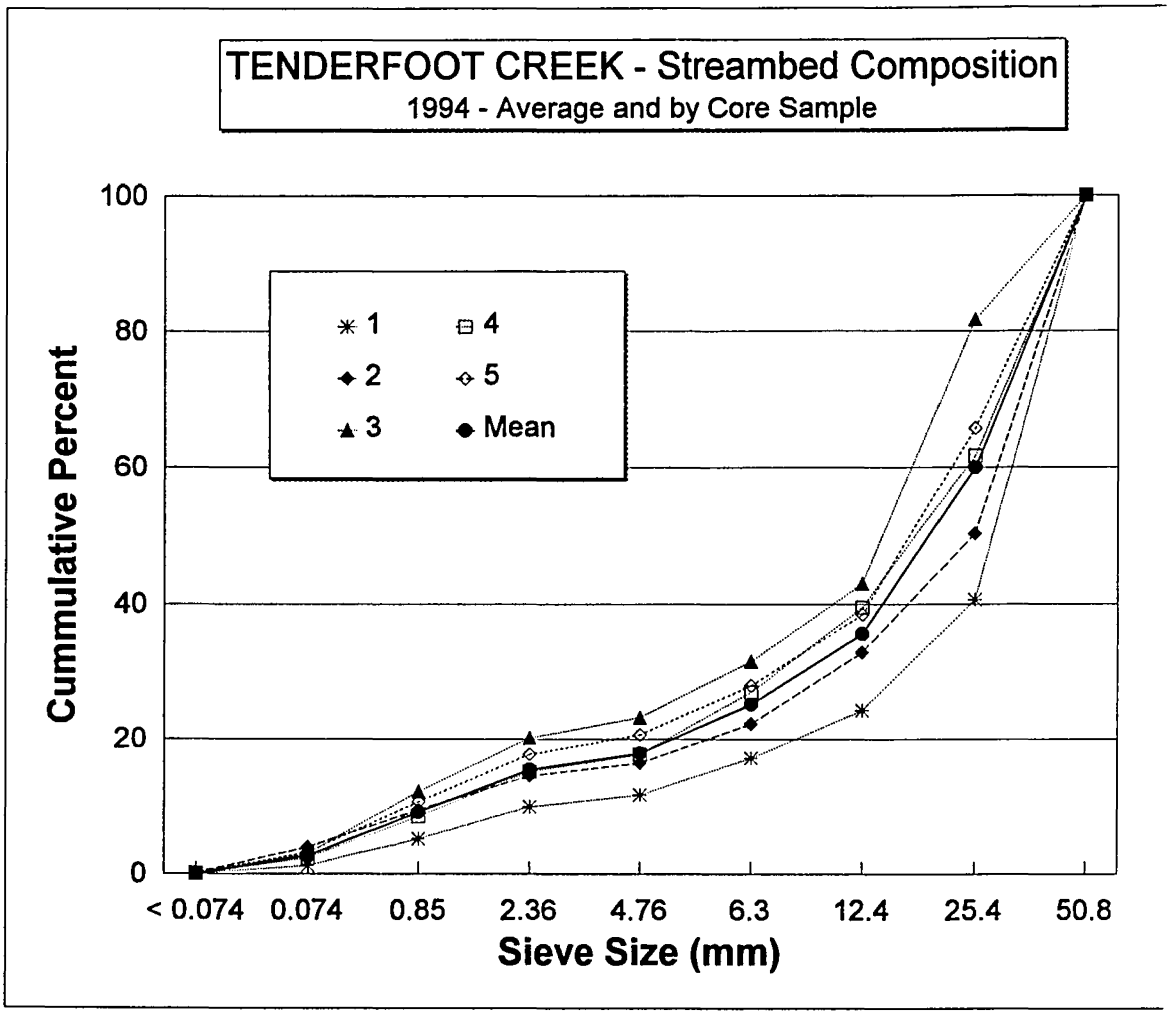

Figure 7. Cumulative distributions of streambed material within spawning habitats in Tenderfoot Creek immediately below Lost Stove Creek from five hollow core samples taken in September 1995.

DISCUSSION

Fish Abundance and Distribution

The distribution of Oncorhynchus spp. within the TCEF is limited to the lower portion of the Experimental Forest, below Spring Park Creek (Figures 1 and 3). Oncorhynchus spp. inhabiting upper Tenderfoot Creek are made up of a hybrid swarm of westslope cutthroat and rainbow trout (Dr. R. Leary, Salmon and Trout Genetics Laboratory, University of Montana, letter dated May 16, 1995). The relative abundance of Oncorhynchus spp. increased in a downstream direction from Spring Park Creek. Brook trout were present throughout Tenderfoot Creek and were more abundant in the upper portions of the drainage, where they existed in allopatry. Mottled sculpins were abundant in the lower portions of Tenderfoot Creek within the TCEF and their upstream distribution appeared to be restricted by a waterfall located about 1.5 km below Stringer Creek. The combined estimated biomass of Oncorhynchus and Salvelinus in Tenderfoot Creek ranged from 0.83 to 6.90 g/m^2. Scarnecchia and Bergersen (1986) estimated that midsummer biomass of Oncorhynchus and Salvelinus in 10 small Colorado streams ranged from 3.9 to 28.2 g/m^2. Their estimates were about four times higher than ours, however, they included all age classes while our estimates only included fish 75 mm and longer. They stated that, "Biomasses of age-groups differed greatly among streams." and suggested that age 0 and 1 age classes made "large contributions to total biomass" for some streams.

We believe that some of the historic releases of hatchery fish were made into the drainage from a road near its headwaters at Onion Park, since this is the only road access to the stream within the upper 22 km of the drainage (Table 1). These released fish, particularly brook trout, appeared to have found suitable low-gradient habitats within the upper portion of the drainage and have thrived there. Cunjak and Green (1984) found that brook trout dominated rainbow trout in five of six trials in slow-flow habitat. They suggested that this dominance by brook trout might be related to brook trout's preference for lentic habitats in natural stream environments. We speculate that brook trout moved downstream from a headwater release site, competing with the native westslope cutthroat trout. Rainbow trout probably moved upstream from a 1955 release site documented by Hanzel (1959). This release was not documented in Montana Fish, Wildlife and Parks' electronic fish stocking database. These rainbow trout have hybridized with the native westslope cutthroat trout. Krueger and May (1991) discussed the ecological and genetic effects which stocking of non-native salmonids have had on native salmonids of North America. These effects include hybridization, competition, predation, and introduction of diseases and parasites.

Estimated populations of Oncorhynchus spp. and brook trout varied little between years (Figure 4), despite relatively large annual differences in flow regimes in the Smith River (Figure 2). Fluctuation in flows in these headwater areas may not have been as extreme as in the Smith River, however, Farnes et al.'s (1995) data indicated that flows during the summer months were two to five times higher in 1993 than in 1994. In addition, groundwater inputs that we observed in the upper portion of Tenderfoot Creek may buffer fish populations from extremes in flows and

temperatures. Several studies have shown that trout prefer habitats near groundwater sources during summer (Bowlby and Roff 1986) and winter (Cunjak and Power 1986; Brown and Mackay 1995). Platts and Nelson (1988) reported that annual fluctuations in salmonid populations in the Intermountain region of the Western United States were generally large. House (1995) also observed that coastal cutthroat trout (Oncorhynchus clarki clarki) populations fluctuated from year to year in the Dead Horse Canyon Creek watershed of western Oregon. His estimates included estimates of young of the year that he found varied the most between years. We did not make estimates for young of the year which we suspect would have fluctuated more than did our estimates of fish 75 mm and longer.

Fish Movement

Our assessments of movement from recaptures of tagged fish and proportion of "new" fish captured in repeated sampling were contradictory (Tables 4 and 5). Few tagged or fin clipped Oncorhynchus spp. were recaptured (only 13 recapture events) over the course of this study, however, these few recaptures suggest that little movement was occurring during the time periods sampled. Conversely, relatively high proportions of "new" fish were captured in repeated sampling of permanent sample sections (averaging 0.62 to 0.89 in four sections) despite relatively high estimated capture efficiencies (averaging 0.82 to 0.93). A total of 161 Oncorhynchus spp. was tagged with 85 tagged during 1992 and 1993. Those fish tagged during 1992 and 1993 also had their adipose fin clipped as a secondary mark. Tag retention was related to length at tagging (Shepard et al. in prep.) and loss of tags may have slightly biased our results. Tag recovery results suggest that some Oncorhynchus spp. were not moving, however, the results from repeated sampling of permanent sections, and our inability to recapture a large proportion of previously tagged fish, suggest that a significant number of fish were probably moving. The presence of three barriers to upstream fish movement would prevent upstream movement of fish that had moved downstream over these barriers.

Brown and MacKay (1995) found that cutthroat trout in the Ram River drainage of Alberta, Canada were stationary most of the time, however, when they did move, most movements exceeded 100 m. They also found that fish moved up to 7.6 km from summer to overwinter habitats. Workman (1981) found that yearling and age 2 wild rainbow and brown trout (Salmo trutta) immigrated into a chemically treated portion of Sixteen Mile Creek, Montana from adjacent untreated portions of the creek. This immigration and subsequent successful spawning by these immigrants when they matured, resulted in trout populations within the treated section reaching carrying capacity 4 years after treatment. Rinne (1982) found that most of 129 marked Gila trout (Oncorhynchus gilae) in three streams of the Gila National Forest, New Mexico moved less than 100 m, however, a few fish moved long distances downstream. Less than 2% moved upstream over habitat improvement structures. Diana and Lane (1978) also reported little movement by Paiute cutthroat trout (Oncorhynchus clarki seleniris) in Cottonwood Creek, California. Gowen et al. (1994) found substantial movement by trout in streams of Colorado and Wyoming and suggested that many studies of movement were flawed. Riley and Fausch (1995) observed low recapture rates of marked trout and high proportions of unmarked trout in

previously sampled sections that they used to suggest that immigration rates were high. They believed that this inferred movement was an important mechanism that led to increased densities of trout in sections containing habitat improvement structures. Heggenes et al. (1991) found that the majority of a coastal cutthroat trout (Oncorhynchus clarki clarki) population that inhabited a small, coastal stream was static and resided within an area of less than 22 m^2. However, they found that a small fraction of the population was mobile.

Length Frequency, Age, and Growth

Based on the catch of fish less than 75 mm it appears that recruitment of Oncorhynchus spp. is limited in the upper Tenderfoot Creek drainage. There appeared to be slightly higher recruitment in the portion of the stream near the lower boundary of the TCEF than the rest of the TCEF (Figures 3 and 5). Catches of brook trout less than 75 mm indicated recruitment of brook trout is probably relatively high throughout the drainage with higher recruitment rates seen in the upper portion of the drainage (Figure 3). Catches of age 0 brook trout were very low in 1994, suggesting that high fall flows in 1993, coupled with moderately high spring and low summer flows in 1994, might have reduced recruitment of age 0 brook trout in 1994.

Length frequency histograms of Oncorhynchus spp. indicated that relatively few age 1 fish were captured in 1993, followed by relatively high catches of age 2 fish in 1994. We suspect the higher than normal summer flows in 1993 (Farnes et al. 1995 and Figure 2) might have led to a high survival of age 1 to 2 Oncorhynchus spp. from 1993 to 1994.

Survival Estimates

Our estimates of annual survival rates were very crude, due to the difficulty in interpreting the length range for each age class from length frequency plots and demonstrated likelihood for movement by Oncorhynchus spp. into and out of sample sections between years. In spite of these problems, we obtained very consistent estimates for brook trout from age 1 to age 2 which indicated very high annual survival rates (>80%). Flick and Webster (1964) estimated over-summer survival of yearling wild brook trout to be 65 to 76%. Annual survival rates we estimated for age 2 and older brook trout were much more variable. This variation might have been related to movement of larger brook trout out of headwater portions of the drainage. Since we did not assess movement of brook trout we can only speculate on this possibility. McFadden et al. (1967) studied brook trout in a stable stream environment over a 14 year period and concluded that survival from age 1 to age 2 was directly density-dependent, while survival from age 2 to age 3 suggested an inverse density-dependent relationship. Hunt (1969) estimated overwinter survivals of from 35 to 73% for brook trout from 9 months of age to 16 months of age.

Our estimates of annual survival rates for Oncorhynchus spp. were even more likely to be inaccurate due to the relatively small number of fish that were sampled. Miller (1953) estimated survivals of wild cutthroat trout to be 46% and 29% for their second and third summers,

respectively. Our estimated survival of Oncorhynchus spp. from age 1 to age 2 of 35% is relatively close to Miller's estimated survivals, while our survival estimates for fish age 2 and older were higher than Miller's estimate.

CONCLUSIONS

1. The westslope cutthroat trout population inhabiting the upper Tenderfoot Creek drainage within the TCEF consists of a hybrid swarm of westslope cutthroat and rainbow trout.

2. An allopatric population or populations of brook trout inhabit the upper portion of the Tenderfoot Creek drainage above Spring Park Creek where channel gradients are relatively low (about 3% compared to over 5% for the channel down to the TCEF boundary). Oncorhynchus spp. are distributed downstream from Spring Park Creek and make up a progressively larger component of the fish community in a downstream direction to the lower boundary of the TCEF, where they comprised 35-50% of the salmonid community.

3. Mottled sculpins inhabit the lower portion of Tenderfoot Creek up to an identified barrier falls located about 0.2 km below Pack Creek.

4. None of the tributaries to Tenderfoot Creek within the TCEF, except Sun Creek, support fish populations.

5. Cascade/ riffle habitat types were dominant in Tenderfoot Creek. Pools comprised a very small proportion (< 3%) of the stream channel.

6. We found few Oncorhynchus spp. young-of-the-year that suggests very limited recruitment. We observed numerous young-of-the-year brook trout, suggesting their recruitment may be relatively high. We believe it may be worth exploring if competitive exclusion of Oncorhynchus spp. by brook trout is occurring during the first year of life.

RECOMMENDATIONS

1. We suggest that the TCEF may not be the best site for assessing the impacts of timber harvest on fine sediment delivery and its affects on fish populations or fish habitat. Factors influencing this lack of suitability included:

    a. The Tenderfoot Creek channel within the TCEF is primarily a high gradient, sediment transporting, channel which will not serve to evaluate impacts of timber harvest on fine sediment accumulation within the streambed. It may be possible to measure sediment delivery and transport to the channel, but the majority of

delivered sediment will be deposited off the TCEF. The places where timber management most impacts streambed composition occur where relatively high gradient reaches deliver fine sediment to lower gradient reaches. That situation does not exist within the TCEF.

b. The geology of the drainage is such that natural and management induced erosion rates should be relatively low. It would be much better to have a site dominated by either volcanic, altered granitic, or lacustrian depositional geologic settings. These are the underlying geologic materials that usually lead to sediment problems in aquatic systems.

c. The trout population is relatively small and the salmonid community is not one that is of primary concern regarding impacts of forest management on fish resources. An allopatric pure westslope cutthroat trout population without non-native salmonids would be a better indicator of effects.

2. We believe that the TCEF could provide some valuable insight into the function and trend in woody debris recruitment within stream channels and document changes in total water yields and flow regimes related to timber harvest. The TCEF could be used for testing various riparian timber management prescriptions and monitoring their impacts on recruitment of woody debris to stream channels, and migration and decomposition of woody debris within stream channels. Experiments might also provide some insight into the effects of timber harvest on flow regimes and, if flow regimes were altered, the resulting effects of those altered flow regimes on fish populations.

3. We believe that Tenderfoot Creek within the TCEF would not be a good candidate stream for restoration of an allopatric population of native westslope cutthroat trout. We suspect that it would be extremely difficult to remove brook trout from upper Tenderfoot Creek using either mechanical or chemical treatment.

4. However, we suggest that Stringer Creek, which is now fishless, might be a suitable stream for re-founding a pure westslope cutthroat trout population. Its small size and low proportion of pool habitats might be the reason it is now fishless. These factors would make it marginal as a westslope cutthroat trout recovery stream, but it should be further investigated.

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Appendix A

Explanation for database fields in dBase format by file name

Structure for table C:\DBASE\MSUFISH\FISHSUMA.DBF
Table type DBASE
Number of records 661
Last update 10/16/96

Field	Field Name	Type	Length	Dec	Index
1	DRAINAGE	CHARACTER	5		N
2	LOCATION	CHARACTER	25		N
3	SEC_NUMBER	NUMERIC	4	1	N
4	IDCODE	CHARACTER	7		N
5	SEC_LENGTH	NUMERIC	8	1	N
6	WIDTH	NUMERIC	5	1	N
7	COLLECTION	CHARACTER	6		Y
8	DATE	DATE	8		N
9	SEASON	CHARACTER	5		N
10	ESTIMATOR	CHARACTER	1		N
11	WCTP1LT75	NUMERIC	5		N
12	WCTP1GT75	NUMERIC	5		N
13	WCTP1BT75	NUMERIC	5		N
14	WCTP1GT149	NUMERIC	5		N
15	EBTP1LT75	NUMERIC	5		N
16	EBTP1GT75	NUMERIC	5		N
17	EBTP1BT75	NUMERIC	5		N
18	EBTP1GT149	NUMERIC	5		N
19	WCTESTLT75	NUMERIC	6	1	N
20	PROBLT75	NUMERIC	5	3	N
21	WCTSDLT75	NUMERIC	6	1	N
22	WCTLCILT75	NUMERIC	6	1	N
23	WCTUCILT75	NUMERIC	6	1	N
24	WCTEST75	NUMERIC	6	1	N
25	PROB75	NUMERIC	5	3	N
26	WCTSD75	NUMERIC	6	1	N
27	WCTLCI75	NUMERIC	6	1	N
28	WCTUCI75	NUMERIC	6	1	N
29	WCTEST149	NUMERIC	6	1	N
30	PROB149	NUMERIC	5	3	N
31	WCTSD149	NUMERIC	6	1	N
32	WCTLCI149	NUMERIC	6	1	N
33	WCTUCI149	NUMERIC	6	1	N
34	WCTESTGT75	NUMERIC	6	1	N
35	PROBGT75	NUMERIC	5	3	N
36	WCTSDGT75	NUMERIC	6	1	N
37	WCTLCIGT75	NUMERIC	6	1	N
38	WCTUCIGT75	NUMERIC	6	1	N
39	WCTAVELEN	NUMERIC	5	1	N
40	WCTLOWLEN	NUMERIC	4		N
41	WCTHIGHLEN	NUMERIC	4		N
42	WCTSDLEN	NUMERIC	5	1	N
43	WCTAVEWT	NUMERIC	5	1	N
44	WCTLOWWT	NUMERIC	4		N
45	WCTHIGHWT	NUMERIC	4		N
46	WCTSDWT	NUMERIC	5	1	N
47	WCTNUMWT	NUMERIC	4		N
48	EBTESTLT75	NUMERIC	6	1	N
49	EBTSDLT75	NUMERIC	6	1	N
50	EBTLCILT75	NUMERIC	6	1	N
51	EBTUCILT75	NUMERIC	6	1	N
52	EBTEST75	NUMERIC	6	1	N
53	EBTSD75	NUMERIC	6	1	N
54	EBTLCI75	NUMERIC	6	1	N

Field	Field Name	Type	Length	Dec	Index
55	EBTUCI75	NUMERIC	6	1	N
56	EBTEST149	NUMERIC	6	1	N
57	EBTSD149	NUMERIC	6	1	N
58	EBTLCI149	NUMERIC	6	1	N
59	EBTUCI149	NUMERIC	6	1	N
60	EBTESTGT75	NUMERIC	6	1	N
61	EBTSDGT75	NUMERIC	6	1	N
62	EBTLCIGT75	NUMERIC	6	1	N
63	EBTUCIGT75	NUMERIC	6	1	N
64	EBTAVELEN	NUMERIC	5	1	N
65	EBTLOWLEN	NUMERIC	4		N
66	EBTHIGHLEN	NUMERIC	4		N
67	EBTSDLEN	NUMERIC	5	1	N
68	EBTAVEWT	NUMERIC	5	1	N
69	EBTLOWWT	NUMERIC	4		N
70	EBTHIGHWT	NUMERIC	4		N
71	EBTSDWT	NUMERIC	5	1	N
72	EBTNUMWT	NUMERIC	4		N
73	COMMENTS	CHARACTER	50		N
** Total **			457		

The following lists each field name which appears in the FISHSUMA.DBF file and explains what data was entered into each field.

DRAINAGE Alpha code for tributary drainage where sampling occurred.

LOCATION Enter what appears after "Water Name:". The following are the naming conventions used for this study:

"CABIN CREEK"
"COLLAR GULCH" for Collar Gulch or Collar Creek
"COTTONWOOD CREEK (RUBY)"
"COTTONWOOD CREEK (SMITH)"
"DELANO CREEK"
"DOUGLAS CREEK"
"E FK COTTONWOOD CREEK"
"FLUME CREEK"
"FREEZEOUT CREEK"
"GEYSER CREEK"
"HALF MOON CREEK"
"HALFWAY CREEK"
"JERRY CREEK"
"LEFT FORK STONE CREEK"
"LICK CREEK"
"M FK CABIN CREEK"
"M FK DOUGLAS CREEK"
"M FK STONE CREEK"
"MCVEY CREEK"
"MUSKRAT CREEK"
"N FK DEADMAN CREEK"
"N FK DOUGLAS CREEK"
"N FK GOLD CREEK"
"N FK MCVEY CREEK"
"SE TRIB TO W FK COTTONWOOD"
"SOAP CREEK"
"SPRING GULCH"
"SPRING PARK CREEK (SD#2)"
"STRINGER CREEK"
"SUN CREEK (SD#1)"
"TENDERFOOT CREEK"
"TRIB TO DELANO CREEK"
"TRIB TO GEYSER CREEK"
"TRIB TO HALFWAY CREEK"
"TRIB TO MCVEY CREEK"
"TRIB TO N FK DEADMAN CK"
"TRIB TO W FK COTTONWOOD CK"
"W FK COTTONWOOD CREEK"
"WHITE'S GULCH"

SEC_NUMBER Type in the number of the section. This number should appear at the top of the page or near the "Section:" portion with a "#" beside it.

SEC_LENGTH Enter the length of the section in meters. This number should appear after "Length:". Please note that for fish estimate sections where habitat surveys are done it is best to enter the habitat data first and sum the lengths of the habitat units to enter for section length rather than paced estimates.

WIDTH Average width of the section sampled. This number will appear after "Width:". Please note that for fish estimate sections where habitat surveys are done it is best to enter the habitat data first and average the widths of the habitat units to enter for section width rather than use visual estimates.

COLLECTION This is the six digit alphanumeric code after the "Collection code:" in the header information. It begins with "MXX" followed by three more numerals. The "XX" indicates the year of sampling. This unique code identifies each sample episode.

DATE The date the section was sampled.

SEASON Season and year coded as first two letters of season followed by last two numbers of year.

ESTIMATOR The "Estimate type:" with the following code: "1-Pass" = "1"; "2-pass" = "2"; "3-Pass" = "3"; and so on with Mark-Recapture="P"; visual survey from above water with an "I"; count of total numbers with an "N".

WCT1PLT75 Number of westslope cutthroat (WCT) or eastern brook
EBT1PLT75 trout (EBT) captured on the first electrofishing pass which were less than 75 mm (fork length). Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.

WCT1PGT75 Number of westslope cutthroat (WCT) or eastern brook
EBT1PGT75 trout (EBT) captured on the first electrofishing pass which were 75 mm (fork length) and longer. Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.

WCT1BT75 Number of westslope cutthroat (WCT) or eastern brook
EBT1BT75 trout (EBT) captured on the first electrofishing pass which were from 75 mm (fork length) to 149 mm. Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.

WCT1GT149 Number of westslope cutthroat (WCT) or eastern brook
EBT1GT149 trout (EBT) captured on the first electrofishing pass which were longer than 149 mm (fork length). Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.

WCTESTLT75 Estimated number of westslope cutthroat (WCT) or
EBTESTLT75 eastern brook trout (EBT) less than 75 mm (fork length). Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.

PROBLT75 Estimated probability of capture for westslope cutthroat (WCT) less than 75 mm (fork length). Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.

WCTSDLT75 Estimated standard deviation for population estimate
EBTSDLT75 of westslope cutthroat (WCT) or eastern brook trout (EBT) less than 75 mm (fork length). Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.

WCTLCILT75 Estimated lower confidence limit (LCI) and upper
EBTLCILT75 confidence limit (UCI) for population estimates of
WCTUCILT75 westslope cutthroat (WCT) or eastern brook trout
EBTUCILT75 (EBT) less than 75 mm (fork length). Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.

WCTEST75
EBTEST75 Estimated number of westslope cutthroat (WCT) or eastern brook trout (EBT) from 75 mm (fork length) to 149 mm. Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.

PROB75 Estimated probability of capture for westslope cutthroat (WCT) from 75 mm (fork length) to 149 mm. Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.

WCTSD75
EBTSD75 Estimated standard deviation for population estimate of westslope cutthroat (WCT) or eastern brook trout (EBT) from 75 mm (fork length) to 149 mm. Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.

WCTLCI75
EBTLCI75
WCTUCI75
EBTUCI75 Estimated lower confidence limit (LCI) and upper confidence limit (UCI) for population estimates of westslope cutthroat (WCT) or eastern brook trout (EBT) from 75 mm (fork length) to 149 mm. Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.

WCTEST149
EBTEST149 Estimated number of westslope cutthroat (WCT) or eastern brook trout (EBT) longer than 149 mm (fork length). Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.

PROB149 Estimated probability of capture for westslope cutthroat (WCT)) longer than 149 mm (fork length). Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.

WCTSD149
EBTSD149 Estimated standard deviation for population estimate of westslope cutthroat (WCT) or eastern brook trout (EBT)) longer than 149 mm (fork length). Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.

WCTLCI149 Estimated lower confidence limit (LCI) and upper
EBTLCI149 confidence limit (UCI) for population estimates of
WCTUCI149 westslope cutthroat (WCT) or eastern brook trout
EBTUCI149 (EBT)) longer than 149 mm (fork length). Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.

WCTESTGT75 Estimated number of westslope cutthroat (WCT) or
EBTESTGT75 eastern brook trout (EBT) 75 mm (fork length) and longer. Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.

PROBGT75 Estimated probability of capture for westslope cutthroat (WCT)) 75 mm (fork length) and longer. Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.

WCTSDGT75 Estimated standard deviation for population estimate
EBTSDGT75 of westslope cutthroat (WCT) or eastern brook trout (EBT)) 75 mm (fork length) and longer. Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.

WCTLCIGT75 Estimated lower confidence limit (LCI) and upper
EBTLCIGT75 confidence limit (UCI) for population estimates of
WCTUCIGT75 westslope cutthroat (WCT) or eastern brook trout
EBTUCIGT75 (EBT)) 75 mm (fork length) and longer. Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.

WCTAVELEN Average length and weight of westslope cutthroat
EBTAVELEN trout (WCT) and eastern brook trout (EBT). Westslope
WCTAVEWT cutthroat trout included all Oncorhynchus spp. which,
EBTAVEWT for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.

WCTLOWLEN Minimum length and weight for westslope cutthroat
EBTLOWLEN trout (WCT) and eastern brook trout (EBT). Westslope
WCTLOWWT cutthroat trout included all Oncorhynchus spp. which,
EBTLOWWT for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.

WCTHIGHLEN EBTHIGHLEN WCTHIGHWT EBTHIGHWT	Maximum length and weight for westslope cutthroat trout (WCT) and eastern brook trout (EBT). Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.
WCTSDLEN EBTSDLEN WCTSDWT EBTSDWT	Standard deviation of average length and weight of westslope cutthroat trout (WCT) and eastern brook trout (EBT). Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.
WCTNUMWT EBTNUMWT	Number of fish for average length and weight for westslope cutthroat trout (WCT) and eastern brook trout (EBT). Westslope cutthroat trout included all Oncorhynchus spp. which, for some streams, may have included hybrids between rainbow trout and westslope cutthroat trout.
COMMENTS	Comments.

Structure for table ALLTRIB.DBF
Table type DBASE
Number of records 19166
Last update 08/27/96

Field	Field Name	Type	Length	Dec	Index
1	LENGTH_MM	NUMERIC	6	1	N
2	WEIGHT_GM	NUMERIC	4		N
3	CONDITION	NUMERIC	5	3	N
4	MARKCODE	CHARACTER	1		N
5	MORT	LOGICAL	1		N
6	HOOKSCAR	LOGICAL	1		N
7	SEX	CHARACTER	1		N
8	MATURITY	CHARACTER	5		N
9	TAGTYPE	CHARACTER	2		N
10	TAGCOLOR	CHARACTER	2		N
11	TAGNUMBER	CHARACTER	6		N
12	TAGRATING	CHARACTER	1		N
13	TAGKM	NUMERIC	5	2	N
14	TAGRECAP	LOGICAL	1		N
15	FINCLIP	LOGICAL	1		N
16	FINCLIPPED	CHARACTER	2		N
17	FINRECAP	LOGICAL	1		N
18	RUNNUMBER	CHARACTER	1		N
19	TRIPTYPE	CHARACTER	1		N
20	MR_CODE	CHARACTER	6		N
21	COLLECTION	CHARACTER	6		N
22	SPEC_NUM	CHARACTER	3		N
23	LENGTH	NUMERIC	6	1	N
24	WEIGHT	NUMERIC	6	2	N
25	LOCATION	CHARACTER	25		N
26	SEC_NAME	CHARACTER	45		N
27	SEC_NUMBER	NUMERIC	4	1	N
28	STREAMKM	NUMERIC	5	2	N
29	LEGAL	CHARACTER	16		N
30	DATE	DATE	8		N
31	SEASON	CHARACTER	4		N
32	SEC_LENGTH	NUMERIC	8	1	N
33	LENGTHUNIT	CHARACTER	4		N
34	LENGTHDQR	CHARACTER	1		N
35	SECONDS1	NUMERIC	5		N
36	WIDTH	NUMERIC	5	1	N
37	WIDTHUNIT	CHARACTER	4		N
38	WIDTHDQR	CHARACTER	1		N
39	ESTIMATOR	CHARACTER	1		N
40	DRAINAGE	CHARACTER	5		N
41	LOGLEN	NUMERIC	6	4	N
42	LOGWT	NUMERIC	6	4	N
** Total **			228		

The following lists each field name which appears in the ALLTRIB.DBF file and explains what data was entered into each field.

LENGTH_MM Length of the fish in mm recorded as FORK LENGTH.

WEIGHT_GM Weight of the fish in grams.

MARKCODE "0" or "1". This field is a "0" unless the fish is a tag recapture, in which case recaptured fish will be coded with a "1".

MORT A "T" if the fish was a mortality.

HOOKSCAR Indicates the presence of a noticeable hooking scar.

SEX A "M" if a male (♂) or a "F" if a female (♀). If blank indicates sex could not be determined easily.

MATURITY Enter "RIPE" if gametes easily extruded; "IMMAT" if immature; "SPENT" if spent female or male; "MATUR" indicates mature - if secondary sexual characteristics present or females gravid; blank if unable to determine maturity.

TAGTYPE "VI" indicates fish tagged with a visible implant tag.

TAGCOLOR Tag color coded as: "WH" for white tags with black alpha-numeric characters; "BK" for black tags with white alpha-numeric characters; "Y" for yellow tags with black alpha-numeric characters.

TAGNUMBER This is a three digit alpha numeric code with the first two digits being letters "A-Z" and the last digit being a numeral "0,1,2,...,9".

TAGRATING Rating of tag insertion quality from "1" to "3" with "1" indicating good tag insertion; "2" indicating some problem with tag insertion which may affect retention or subsequent ability to read the tag; and "3" indicating a major problem with tag insertion.

TAGKM Stream kilometer where fish was tagged or recaptured. Stream kilometers are either distance upstream from mouth or from a distinct landmark.

TAGRECAP "T" if the fish was recaptured with a tag; otherwise a

"F".

FINCLIP "T" if a fin clip was used or observed.

FINCLIPPED The fin which was clipped coded as: "LP" for left pelvic; "RP" for right pelvic; or "AD" for adipose.

FINRECAP "T" if fish recaptured with a previous fin clip.

RUNNUMBER Electrofishing pass number. "1" if the fish was captured on the first pass; a "2" if the fish was captured on the second pass ("Pass 2"); a "3" if the fish was captured on the third pass, etc.

TRIPTYPE Indicates if Mark-Recapture estimate was used whether is is a marking run, coded as "1", or a recapture run, coded as "2".

MR_CODE Mark-recpature estimate code to indicate if fish was recaptued or not. Coded as "0" for newly captured fish and "1" for recaptured fish.

COLLECTION This is the six digit alphanumeric code after the "Collection code:" in the header information. It begins with "MXX" followed by three more numerals. The "XX" indicates the year of sampling. This unique code identifies each sample episode.

SPEC_NUM Species number code for each species of fish. The three letter species codes and their respective numeric species codes are: WCT = "012" (westslope cutthroat trout); EBT = "003" (brook trout); RB = "001" (rainbow trout); HB = "011" (hybrids between rainbow and westslope cutthroat trout); LL = "004" (brown trout).

LENGTH Fork length in mm.

WEIGHT Weight in grams.

LOCATION Enter what appears after "Water Name:". The following are the naming conventions used for this study:
"CABIN CREEK"
"COLLAR GULCH" for Collar Gulch or Collar Creek
"COTTONWOOD CREEK (RUBY)"
"COTTONWOOD CREEK (SMITH)"
"DELANO CREEK"

"DOUGLAS CREEK"
"E FK COTTONWOOD CREEK"
"FLUME CREEK"
"FREEZEOUT CREEK"
"GEYSER CREEK"
"HALF MOON CREEK"
"HALFWAY CREEK"
"JERRY CREEK"
"LEFT FORK STONE CREEK"
"LICK CREEK"
"M FK CABIN CREEK"
"M FK DOUGLAS CREEK"
"M FK STONE CREEK"
"MCVEY CREEK"
"MUSKRAT CREEK"
"N FK DEADMAN CREEK"
"N FK DOUGLAS CREEK"
"N FK GOLD CREEK"
"N FK MCVEY CREEK"
"SE TRIB TO W FK COTTONWOOD"
"SOAP CREEK"
"SPRING GULCH"
"SPRING PARK CREEK (SD#2)"
"STRINGER CREEK"
"SUN CREEK (SD#1)"
"TENDERFOOT CREEK"
"TRIB TO DELANO CREEK"
"TRIB TO GEYSER CREEK"
"TRIB TO HALFWAY CREEK"
"TRIB TO MCVEY CREEK"
"TRIB TO N FK DEADMAN CK"
"TRIB TO W FK COTTONWOOD CK"
"W FK COTTONWOOD CREEK"
"WHITE'S GULCH"

SEC_NAME The name of the section which describes where the section is located within the stream.

SEC_NUMBER The number of the section.

STREAMKM The stream kilometer up from either the mouth or a permanent easily referenced point on the stream.

LEGAL The legal description of the sample site (Township;Range;Section; and quarter section coded as A,B,C, or D)

DATE The date the section was sampled.

SEASON Season and year coded as first two letters of season followed by last two numbers of year.

SEC_LENGTH The length of the section in meters. For fish estimate sections where habitat surveys were done the sum of the lengths of the habitat units were used for section length rather than paced estimates.

LENGTHUNIT An "M" for meters or "FT" for feet.

LENGTHDQR DQR is the data quality rating for each estimate. DQR's are rated as follows: 0 - wild guess; 1 - map guess; 2 - road survey; 3 to 4 - visual estimate with no measurements; 5 - paced type of estimate; 6 to 8 - increasing level of measurements; 9 - actual surveying of the site with rod, level, and tape

SECONDS1 The number of seconds actually shocked in each pass indicated after "SECONDS".

WIDTH Average width of the section sampled. For fish estimate sections where habitat surveys were done, average widths were obtained from the habitat data.

WIDTHUNIT Usually an "M" for meters.

WIDTHDQR The DQR is the data quality rating for each estimate. The width DQR is found immediately after the units. Enter the number. NOTE: DQR's are rated as above under LENGTHDQR.

ESTIMATOR The "Estimate type:" with the following code: "1-Pass" = "1"; "2-pass" = "2"; "3-Pass" = "3"; and so on with Mark-Recapture="P"; "Angling" with a "A"; visual survey from above water with an "I"; count of total numbers with an "N".

DRAINAGE Alpha code for tributary drainage where sampling occurred.

LOGLEN Log of fork length in mm.

LOGWT Log of weight in grams.

Structure for table C:\DBASE\MSUHAB\ALLSUMST.DBF
Table type DBASE
Number of records 60
Last update 12/04/96

Field	Field Name	Type	Length	Dec	Index
1	COLLECTION	CHARACTER	6		N
2	HABLENGTH	NUMERIC	6	1	N
3	PERBOULDER	NUMERIC	3		N
4	PERCOBBLE	NUMERIC	3		N
5	PERLGGRAV	NUMERIC	3		N
6	PERSMGRAV	NUMERIC	3		N
7	PERSAND	NUMERIC	3		N
8	PERSILT	NUMERIC	3		N
9	INCOVRATE	CHARACTER	2		N
10	INCOVTYPES	CHARACTER	20		N
11	NUMSMWOODY	NUMERIC	3		N
12	NUMLGWOODY	NUMERIC	3		N
13	NUMSMCROSS	NUMERIC	3		N
14	NUMLGCROSS	NUMERIC	3		N
15	SPAWNMSQ	NUMERIC	5	1	N
16	SPAWNCOM	CHARACTER	20		N
17	POOLRATE	CHARACTER	2		N
18	POOLCOM	CHARACTER	25		N
19	BANKRATE	CHARACTER	2		N
20	BANKCOM	CHARACTER	25		N
21	BANKCOVRAT	CHARACTER	2		N
22	BANKCOVCOM	CHARACTER	25		N
23	RIPARVEG	CHARACTER	30		N
24	RIPUSERATE	CHARACTER	2		N
25	RIPUSECOM	CHARACTER	25		N
26	COMMENTS	CHARACTER	50		N
27	PERPOOL	NUMERIC	3		N
28	AVELENPOOL	NUMERIC	5	1	N
29	AVEWIDTHPL	NUMERIC	5	1	N
30	AVEDEPTHPL	NUMERIC	5	1	N
31	MAXDEPTHPL	NUMERIC	5		N
32	RESIDVOLPL	NUMERIC	6	3	N
33	PERRIFFLE	NUMERIC	3		N
34	AVELENRIF	NUMERIC	5	1	N
35	AVEWIDTHRF	NUMERIC	5	1	N
36	AVEDEPTHRF	NUMERIC	5	1	N
37	PERRUN	NUMERIC	3		N
38	AVELENRUN	NUMERIC	5	1	N
39	AVEWIDTHRN	NUMERIC	5	1	N
40	AVEDEPTHRN	NUMERIC	5	1	N
41	LOCATION	CHARACTER	25		N
42	SEC_NUMBER	NUMERIC	4	1	N
43	DATE	DATE	8		N
44	SEC_LENGTH	NUMERIC	8	1	N
** Total **			388		

The following lists each field name which appears in the ALLSUMST.DBF file and explains what data was entered into each field.

COLLECTION	Collection code.
HABLENGTH	Length of stream where habitat survey was done.
PERBOULDER PERCOBBLE PERLGGRAV PERSMGRAV PERSAND PERSILT	Percent of surficial substrate which was comprised of boulder, cobble, large gravel, small gravel, sand, and silt. Estimated across entire surveyed section of streambed.
INCOVRATE	Instream cover rating (see attached sheet for ratings).
INCOVTYPES	What features created instream cover.
NUMSMWOODY NUMLGWOODY	Number of small (<150 mm) and large (≥150 mm) woody debris within the bankfull width of the stream channel.
NUMSMCROSS NUMLGWOODY	Number of small (<150 mm) and large (≥150 mm) woody debris across the entire wetted channel.
SPAWNSQM	Total square meters of available spawning habitat within the survey reach. Spawning habitat is defined as patches of substrate dominated by material 1 to 3 cm which cover at least 0.3 m^2.
SPAWNCOM	Any comments related to spawning habitat.
POOLRATE	Rating of pool quality and quantity for the survey section (see attached rating sheet for ratings).
POOLCOM	Any comments related to pool habitats.
BANKRATE	Rating of bank stability and condition (see attached rating sheet).
BANKCOM	Any comments related to bank condition.
BANKCOVRATE	Rating of the amount and density of cover provided by, or on, streambanks. This relates to bank

vegetation and overhanging banks.

BANKCOVCOM — Any comments related to bank cover and what is forming bank cover.

RIPARVEG — Listing of types of species which comprise riparian community - common names only.

RIPUSERATE — Rating indicating the amount of brousing or grazing use on riparian vegetation and stream banks (see attached ratings).

COMMENTS — General comments related to the entire habitat section.

PERPOOL — Percentage of pool habitats in section based on length.

AVELENPOOL — Average length of pool habitats in meters.

AVEWIDTHPL — Average width of pool habitats in meters.

AVEDEPTHPL — Average depth of pool habitats in centimeters.

MAXDEPTHPL — Average maximum depth pools in centimeters.

RESIDVOLPL — Residual volume of pools in cubic meters which is calculated by: $(D_{max}*W*L)-(D_{tail}*W*L)$; where:
D_{max} = average maximum depth of pools
W = average width of pools
L = average length of pools, and
D_{tail} = average maximum depth of pool tailout.

PERRIFFLE
AVELENRIF
AVEWIDTHRF
AVEDEPTHRF
PERRUN
AVELENRUN
AVEWIDTHRN
AVEDEPTHRN

Percentage of riffle and run habitats in the section based on length. Average length, width and depth of riffle and run habitats.

LOCATION — Enter what appears after "Water Name:". The following are the naming conventions used for this study:
"CABIN CREEK"
"COLLAR GULCH" for Collar Gulch or Collar Creek
"COTTONWOOD CREEK (RUBY)"

"COTTONWOOD CREEK (SMITH)"
"DELANO CREEK"
"DOUGLAS CREEK"
"E FK COTTONWOOD CREEK"
"FLUME CREEK"
"FREEZEOUT CREEK"
"GEYSER CREEK"
"HALF MOON CREEK"
"HALFWAY CREEK"
"JERRY CREEK"
"LEFT FORK STONE CREEK"
"LICK CREEK"
"M FK CABIN CREEK"
"M FK DOUGLAS CREEK"
"M FK STONE CREEK"
"MCVEY CREEK"
"MUSKRAT CREEK"
"N FK DEADMAN CREEK"
"N FK DOUGLAS CREEK"
"N FK GOLD CREEK"
"N FK MCVEY CREEK"
"SE TRIB TO W FK COTTONWOOD"
"SOAP CREEK"
"SPRING GULCH"
"SPRING PARK CREEK (SD#2)"
"STRINGER CREEK"
"SUN CREEK (SD#1)"
"TENDERFOOT CREEK"
"TRIB TO DELANO CREEK"
"TRIB TO GEYSER CREEK"
"TRIB TO HALFWAY CREEK"
"TRIB TO MCVEY CREEK"
"TRIB TO N FK DEADMAN CK"
"TRIB TO W FK COTTONWOOD CK"
"W FK COTTONWOOD CREEK"
"WHITE'S GULCH"

SEC_NUMBER The number of the section.

DATE The date the section was sampled.

SEC_LENGTH The length of the section in meters. For fish estimate sections where habitat surveys were done the sum of the lengths of the habitat units were used for section length rather than paced estimates.

Appendix B

Average weights (g) and estimated numbers of Oncorhynchus spp. and brook trout by size class and total estimated biomass (g/m^2) for six sections sampled in Tenderfoot Creek from 1992 to 1995. Sample sizes for average weights (n) and standard errors for population estimates (S.E.) are provided.

Stream Section Date	Oncorhynchus spp. 75 - 149 mm Mean wt (n)	75 - 149 mm Estimate (S.E.)	150 + mm Mean wt (n)	150 + mm Estimate (S.E.)	Biomass (g/m)
TENDERFOOT CREEK					
0.10					
9/16/94	19.4	28	74.5	34	4.75
	27	1.9	34	0.2	
3.00					
8/18/92	17.1	12	83.5	15	2.13
	11	2.7	14	0.3	
8/24/94	17.0	9	83.9	15	2.07
	9	0.8	16	1.3	
8/22/95	14.7	2	86.4	9	1.18
	3	0.0	20	0.4	
12.00					
8/18/92	27.2	4	126.0	5	1.42
	5	0.6	4	0.0	
8/23/94	24.0	1	78.7	6	0.96
	1	0.0	6	0.5	
8/22/95	0.0	0	75.0	3	0.43
	0	0.0	3	0.0	
14.00					
8/19/92	0.0	0	75.0	5	0.54
	0	0.0	5	0.5	
8/23/94	10.0	1	98.5	4	0.59
	1	0.0	4	0.0	
8/22/95	25.0	1	84.0	3	0.40
	1	0.0	3	0.0	
15.00					
8/20/92	12.0	2	98.2	5	0.74
	2	1.0	5	0.0	
8/30/93	23.0	0	124.0	2	0.36
	1	0.0	2	1.0	
8/23/94	0.0	0	59.0	3	0.25
	0	0.0	3	0.0	
8/21/95	0.0	0	76.0	1	0.11
	0	0.0	1	0.0	
18.00					
8/20/92	0.0	0	0.0	0	0.00
	0	0.0	0	0.0	
8/31/93	0.0	0	0.0	0	0.00
	0	0.0	0	0.0	
8/22/94	0.0	0	0.0	0	0.00
	0	0.0	0	0.0	
8/22/95	0.0	0	0.0	0	0.00
	0	0.0	0	0.0	

Stream Section Date	Brook trout				
	75 - 149 mm		150 + mm		
	Mean wt (n)	Estimate (S.E.)	Mean wt (n)	Estimate (S.E.)	Biomass (g/m)
TENDERFOOT CREEK					
0.10					
9/16/94	27.6	10	101.8	11	2.15
	10	0.3	11	0.3	
3.00					
8/18/92	19.4	13	101.4	23	3.78
	17	1.0	19	0.7	
8/24/94	22.9	23	94.0	22	3.80
	21	3.2	22	0.5	
8/22/95	14.5	13	81.1	27	3.48
	13	1.0	27	0.6	
12.00					
8/18/92	24.3	2	97.8	19	3.68
	3	0.0	18	1.1	
8/23/94	32.2	13	68.1	14	2.65
	12	2.6	14	0.0	
8/22/95	14.8	11	71.3	18	2.79
	10	2.4	18	1.1	
14.00					
8/19/92	25.6	5	88.2	28	3.76
	9	0.0	24	0.4	
8/23/94	33.0	6	96.1	17	2.65
	6	0.0	17	0.3	
8/22/95	13.4	21	70.9	9	1.33
	21	1.0	9	0.4	
15.00					
8/20/92	15.0	5	77.5	2	0.33
	5	1.2	2	0.0	
8/30/93	25.5	0	54.0	6	0.47
	2	0.0	6	1.1	
8/23/94	14.8	4	98.9	9	1.36
	4	0.0	9	0.4	
8/21/95	18.8	4	88.9	9	1.26
	4	0.6	9	0.0	
18.00					
8/20/92	11.6	53	42.0	3	3.23
	52	2.5	1	0.0	
8/31/93	18.9	42	59.8	13	6.23
	39	3.3	13	0.3	
8/22/94	18.7	40	52.3	6	4.21
	38	2.6	6	0.0	
8/22/95	11.1	37	47.0	8	3.12
	37	0.9	8	1.4	

Appendix C

Summary of habitat surveys conducted by Intermountain Research Station personnel in 1991.

Stream ID: BC0820600
EPA Reach: 1003010308206.00
Stream Name: TENDERFOOT CR Forest: LEWIS AND CLARK NF District: KINGS HILL RD Study: D91

Total Number of Units	Gradient MAP	Gradient OBS	Habitat Length(m) Total	Width(m) Mean	% Pools	Max Depth(m) Mean	Width/ Depth Mean	Resid. Vol.(m³) Mean	LWD No. per 100m	% Stbl Bank Mean	% Undrct Bank Mean	% Srfce Fines Mean	Dom. Ripar. Type	From:	Mid:	To:
Survey Reach:1 Reach Type: B			Survey Reach Lower Boundary: Survey Reach Upper Boundary:													
60	3.1	2.3	4,777.4	4.0	2.6	0.60	18.8	9.9	5.0	99.7	3.2	3.0	-	0.0	2,388.7	4,777.4

Stream ID: BC0820600
EPA Reach: 1003010308206.00
Stream Name: TENDERFOOT CR

Forest: LEWIS AND CLARK NF
District: KINGS HILL RD
Study: D91

Habitat Group	Total Number of Units	Habitat Length (m) Total(n)	Mean(n)	Percent(n)	Mean Width (m)(n)	Habitat Depth (m) Mean(n)	Mean-Max(n)	Mean Width/ Depth(n)	Habitat Area (m²) Total(n)	Mean(n)	Percent(n)	Habitat Volume (m³) Total(n)	Mean(n)	Percent(n)
Survey Reach: 1		Survey Reach Lower Boundary:												
Reach Type: B		Survey Reach Upper Boundary:												
DPL	2	16.2(2)	8.1(2)	0.3(2)	3.6(2)	0.34(2)	0.50(2)	10.68(2)	58.1(2)	29.1(2)	0.3(2)	19.6(2)	9.8(2)	0.5(2)
LSP	1	4.7(1)	4.7(1)	0.1(1)	2.8(1)	0.38(1)	0.62(1)	7.37(1)	13.2(1)	13.2(1)	0.1(1)	5.0(1)	5.0(1)	0.1(1)
MCP	7	40.8(7)	5.8(7)	0.9(7)	3.5(7)	0.32(7)	0.53(7)	11.50(7)	144.3(7)	20.6(7)	0.7(7)	45.8(7)	6.5(7)	1.1(7)
NTU	4	204.5(4)	51.1(4)	4.3(4)	4.4(4)	0.25(4)	-	17.81(4)	889.6(4)	222.4(4)	4.6(4)	222.8(4)	55.7(4)	5.2(4)
PLP	10	44.7(10)	4.5(10)	0.9(10)	4.5(10)	0.40(10)	0.67(10)	13.11(10)	199.5(10)	20.0(10)	1.0(10)	78.9(10)	7.9(10)	1.8(10)
SMD	1	18.3(1)	18.3(1)	0.4(1)	3.8(1)	0.38(1)	0.58(1)	10.00(1)	69.5(1)	69.5(1)	0.4(1)	26.4(1)	26.4(1)	0.6(1)
TUR	35	4,448.2(35)	127.1(35)	93.1(35)	4.0(35)	0.22(35)	-	19.01(35)	17,944.5(35)	512.7(35)	92.9(35)	3,926.6(35)	112.2(35)	90.8(35)
Subtotals	60	4,777.4(60)		100.0(60)					19,318.6(60)		100.0(60)	4,325.2(60)		100.0(60)
Means			79.6(60)		4.0(60)	0.22(60)	0.60(21)	18.76(60)		322.0(60)			72.1(60)	
Totals	60	4,777.4(60)		100.0(60)					19,318.6(60)		100.0(60)	4,325.2(60)		100.0(60)
Means			79.6(60)		4.0(60)	0.22(60)	0.60(21)	18.76(60)		322.0(60)			72.1(60)	

Stream ID: BC0820600
EPA Reach: 1003010308206.00
Stream Name: TENDERFOOT CR

Forest: LEWIS AND CLARK NF

District: KINGS HILL RD

Study: D91

Habitat Group	Total Number of Units	Number of Pocket Pools: Total(n)	Mean(n)	per 100 m(n)	Pkt Pool Mean Depth (m)(n)	Total Pools in STPs(n)	Average Max Depth STP Cmplx(n)	Mean Crest Depth (m)(n)	Mean Resid. Max Depth (m)(n)	Residual Volume (m³): Total(n)	Mean(n)	LWD: Total(n)	n/100m(n)
Survey Reach: 1		Survey Reach Lower Boundary:											
Reach Type: B		Survey Reach Upper Boundary:											
DPL	2	-	-	-	-	-	-	0.18(2)	0.33(2)	19.4(2)	9.7(2)	2(2)	12.3(2)
LSP	1	-	-	-	-	-	-	0.25(1)	0.37(1)	4.9(1)	4.9(1)	1(1)	21.3(1)
MCP	7	-	-	-	-	-	-	0.14(7)	0.39(7)	61.3(7)	8.8(7)	3(7)	7.4(7)
NTU	4	3(4)	0.8(4)	1.5(4)	0.23(1)	-	-	-	-	-	-	11(4)	5.4(4)
PLP	10	-	-	-	-	-	-	0.14(10)	0.53(10)	111.6(10)	11.2(10)	20(10)	44.7(10)
SMD	1	-	-	-	-	0(1)	0.00(1)	-	-	-	-	5(1)	27.3(1)
TUR	35	142(35)	4.1(35)	3.2(35)	0.38(30)	-	-	-	-	-	-	196(35)	4.4(35)
Subtotals	60	145(39)				0(1)				197.2(20)		238(60)	
Means			3.7(39)	3.1(39)	0.38(31)		0.00(1)	0.15(20)	0.46(20)		9.9(20)		5.0(60)
Totals	60	145(39)				0(1)				197.2(20)		238(60)	
Means			3.7(39)	3.1(39)	0.38(31)		0.00(1)	0.15(20)	0.46(20)		9.9(20)		5.0(60)

Summary of Main Channel Bank Stability and Undercut

Listing by Survey Reach and by Habitat Group

Stream ID: BC0820600

EPA Reach: 1003010308206.00

Stream Name: TENDERFOOT CR Forest: LEWIS AND CLARK NF District: KINGS HILL RD Study: D91

Habitat Group	Total Number of Units	Bank Length (m)		% Stable Bank			% Unstable Bank			% Undercut Bank		
		Left(n)	Right(n)	Left(n)	Right(n)	Mean(n)	Left(n)	Right(n)	Mean(n)	Left(n)	Right(n)	Mean(n)
Survey Reach: 1		Survey Reach Lower Boundary:										
Reach Type: B		Survey Reach Upper Boundary:										
DPL	2	21.8(2)	16.2(2)	100.00(2)	69.75(2)	87.11(2)	0.00(2)	30.25(2)	12.89(2)	0.00(2)	0.00(2)	0.00(2)
LSP	1	5.8(1)	5.8(1)	100.00(1)	100.00(1)	100.00(1)	0.00(1)	0.00(1)	0.00(1)	100.00(1)	0.00(1)	50.00(1)
MCP	7	47.7(7)	51.5(7)	100.00(7)	100.00(7)	100.00(7)	0.00(7)	0.00(7)	0.00(7)	0.00(7)	0.00(7)	0.00(7)
NTU	4	222.6(4)	222.6(4)	100.00(4)	100.00(4)	100.00(4)	0.00(4)	0.00(4)	0.00(4)	15.00(4)	4.90(4)	9.95(4)
PLP	10	60.5(10)	59.4(10)	77.02(10)	100.00(10)	88.41(10)	22.98(10)	0.00(10)	11.59(10)	2.48(10)	0.00(10)	1.25(10)
SMD	1	20.5(1)	20.5(1)	100.00(1)	100.00(1)	100.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)
TUR	35	4,653.3(35)	4,654.5(35)	99.76(35)	100.00(35)	99.88(35)	0.24(35)	0.00(35)	0.12(35)	2.65(35)	3.24(35)	2.95(35)
Subtotals	60	5,032.2(60)	5,030.5(60)									
Means				99.50(60)	99.90(60)	99.70(60)	0.50(60)	0.10(60)	0.30(60)	3.26(60)	3.22(60)	3.24(60)
Totals	60	5,032.2(60)	5,030.5(60)									
Means				99.50(60)	99.90(60)	99.70(60)	0.50(60)	0.10(60)	0.30(60)	3.26(60)	3.22(60)	3.24(60)

Stream ID: BC0820600
EPA Reach: 1003010308206.00
Stream Name: TENDERFOOT CR

Forest: LEWIS AND CLARK NF
District: KINGS HILL RD
Study: D91

Habitat Group	Total Number of Units	Number of Meas. Units	Number of Est. Units	Mean Percent Substrate Coverage								Mean % Surface Fines
				Fines	Small Gravel	Gravel	Small Cobble	Cobble	Small Boulder	Boulder	Bedrock	
Survey Reach:1		Survey Reach Lower Boundary:										
Reach Type: B		Survey Reach Upper Boundary:										
DPL	2	-	-	-	-	-	-	-	-	-	-	5.0
LSP	1	-	-	-	-	-	-	-	-	-	-	3.0
MCP	7	-	-	-	-	-	-	-	-	-	-	2.0
NTU	4	-	-	-	-	-	-	-	-	-	-	-
PLP	10	-	-	-	-	-	-	-	-	-	-	2.2
SMD	1	-	-	-	-	-	-	-	-	-	-	-
TUR	35	-	-	-	-	-	-	-	-	-	-	3.2
Subtotals	60	-										
Means			-	-	-	-	-	-	-	-	-	3.0
Totals	60	-										
Means			-	-	-	-	-	-	-	-	-	3.0

Stream ID: BC0820600
EPA Reach: 1003010308206.00
Stream Name: TENDERFOOT CR

Forest: LEWIS AND CLARK NF

District: KINGS HILL RD

Study: D91

Habitat Group	Total Number of Units	Single Pieces Tot#	Single Pieces Mean#	Single Pieces #/100m	Single Pieces Mean Diam.	Single Pieces Mean Length	Single Pieces Vol (m³)	Single Pieces %Sub.Vol	Aggregates Tot#	Aggregates Mean#	Aggregates #/100m	Aggregates # Pieces	Root Wads Tot#	Root Wads Mean#	Root Wads #/100m
Survey Reach:1		Survey Reach Lower Boundary:													
Reach Type: B		Survey Reach Upper Boundary:													
DPL	2	0	0.0	0.0	-	-	-	-	2	1.0	12.3	18	0	0.0	0.0
LSP	1	0	0.0	0.0	-	-	-	-	1	1.0	21.3	-	0	0.0	0.0
MCP	7	2	0.3	4.9	0.28	15.5	2.96	0.00	1	0.1	2.5	3	0	0.0	0.0
NTU	4	9	2.3	4.4	0.26	8.8	4.63	0.00	2	0.5	1.0	6	0	0.0	0.0
PLP	10	15	1.5	33.6	0.26	9.5	9.78	0.00	4	0.4	8.9	59	1	0.1	2.2
SMD	1	5	5.0	27.3	0.24	11.4	2.46	0.00	0	0.0	0.0	-	0	0.0	0.0
TUR	35	120	3.4	2.7	0.25	10.9	89.85	0.00	63	1.8	1.4	537	13	0.4	0.3
Subtotals	60	151					109.69	0.00	73			623	14		
Means			2.5	3.2	0.25	10.7				1.2	1.5			0.2	0.3
Totals	60	151					109.69	0.00	73			623	14		
Means			2.5	3.2	0.25	10.7				1.2	1.5			0.2	0.3

Stream & Study: TENDERFOOT CR BC1070000 D91

Tributary of:	SMITH R		
Survey Reach No.:	2		
Reach Type:	B	Habitat Observer:	D.SASS
Forest:	15 - LEWIS AND CLARK NF	Habitat Recorder:	D.SASS
District:	07 - KINGS HILL RD	Diver 1:	
Admin. Forest:	-	Diver 2:	
Admin. District:	-	Map Gradient:	4.8
Ecoregion - Bailey:	M3112	Field Gradient:	2.9
Ecoregion - Omernik:	16	Flow:	0.20
Gross Geology:	GRANITIC	Elevation:	1987
Sub Geology:		Confinement:	M
Township, Range, Sec:	T14N_R06E_S36	Cover Group:	
Base Quad Map Name:	BUBBLING SPRINGS	Weather:	CLEAR
Survey Reach Long:		Non FS Inclusions:	N
Survey Reach Lat:		Other Owners:	
EPA Reach No.:	1003010310700.00	Wilderness (Y/N):	N
Lower EPA Boundary:	STRINGER CR		
Upper EPA Boundary:	HEADWATERS		
First Date of Survey:	10/10/1991		
Unit (Metric/English:	M		
Lower Boundary:			
Upper Boundary:			
Channel Type:			
Comments:			

Tributary of:	SMITH R		
Survey Reach No.:	3		
Reach Type:	B	Habitat Observer:	D.SASS
Forest:	15 - LEWIS AND CLARK NF	Habitat Recorder:	D.SASS
District:	07 - KINGS HILL RD	Diver 1:	
Admin. Forest:	-	Diver 2:	
Admin. District:	-	Map Gradient:	5.2
Ecoregion - Bailey:	M3112	Field Gradient:	2.0
Ecoregion - Omernik:	16	Flow:	0.10
Gross Geology:	GRANITIC	Elevation:	2128
Sub Geology:		Confinement:	M
Township, Range, Sec:	T13N_R07E_S05	Cover Group:	
Base Quad Map Name:	BUBBLING SPRINGS	Weather:	CLEAR
Survey Reach Long:		Non FS Inclusions:	N

Survey Reach Lat:
EPA Reach No.: 1003010310700.00
Lower EPA Boundary: STRINGER CR
Upper EPA Boundary: HEADWATERS
First Date of Survey: 10/12/1991
Unit (Metric/English: M
Lower Boundary:
Upper Boundary:
Channel Type:
Comments: THE SURVEY ENDED IN ONION PARK.

Other Owners:
Wilderness (Y/N): N

Stream ID: BC1070000

EPA Reach: 1003010310700.00

Stream Name: TENDERFOOT CR Forest: LEWIS AND CLARK NF District: KINGS HILL RD Study: D91

Total Number of Units	Gradient MAP	Gradient OBS	Habitat Length(m) Total	Width(m) Mean	% Pools	Max Depth(m) Mean	Width/ Depth Mean	Resid. Vol.(m3) Mean	LWD No. per 100m	% Stbl Bank Mean	% Undrct Bank Mean	% Srfce Fines Mean	Dom. Ripar. Type	From:	Mid:	To:
Survey Reach:2 Reach Type: B			Survey Reach Lower Boundary: Survey Reach Upper Boundary:													
42	4.8	2.9	2,962.4	2.6	2.1	0.52	24.1	3.9	5.0	100.0	0.0	4.7	-	0.0	1,481.2	2,962.4
Survey Reach:3 Reach Type: B			Survey Reach Lower Boundary: Survey Reach Upper Boundary:													
41	5.2	2.0	1,632.3	1.6	8.9	0.49	15.5	16.9	3.2	100.0	11.9	67.7	-	2,962.4	3,778.6	4,594.7

Stream ID: BC1070000
EPA Reach: 1003010310700.00
Stream Name: TENDERFOOT CR

Forest: LEWIS AND CLARK NF

District: KINGS HILL RD

Study: D91

Habitat Group	Total Number of Units	Habitat Length (m) Total(n)	Mean(n)	Percent(n)	Mean Width (m)(n)	Habitat Depth (m) Mean(n)	Mean-Max(n)	Mean Width/ Depth(n)	Habitat Area (m²) Total(n)	Mean(n)	Percent(n)	Habitat Volume (m³) Total(n)	Mean(n)	Percent(n)
Survey Reach: 2		Survey Reach Lower Boundary:												
Reach Type: B		Survey Reach Upper Boundary:												
LSP	2	8.3(2)	4.2(2)	0.3(2)	2.6(2)	0.23(2)	0.49(2)	11.53(2)	21.6(2)	10.8(2)	0.3(2)	4.9(2)	2.5(2)	0.5(2)
MCP	8	18.1(8)	2.3(8)	0.6(8)	2.7(8)	0.26(8)	0.47(8)	10.78(8)	49.3(8)	6.2(8)	0.6(8)	12.6(8)	1.6(8)	1.4(8)
NTU	4	360.7(4)	90.2(4)	12.2(4)	1.1(4)	0.09(4)	-	15.05(4)	411.2(4)	102.8(4)	5.3(4)	36.1(4)	9.0(4)	4.0(4)
PLP	9	19.6(9)	2.2(9)	0.7(9)	3.0(9)	0.36(9)	0.60(9)	9.50(9)	59.6(9)	6.6(9)	0.8(9)	21.6(9)	2.4(9)	2.4(9)
RUN	1	19.4(1)	19.4(1)	0.7(1)	1.7(1)	0.11(1)	0.20(1)	15.45(1)	33.0(1)	33.0(1)	0.4(1)	3.6(1)	3.6(1)	0.4(1)
SMD	1	14.9(1)	14.9(1)	0.5(1)	2.7(1)	0.30(1)	0.53(1)	9.00(1)	40.2(1)	40.2(1)	0.5(1)	12.1(1)	12.1(1)	1.3(1)
TUR	17	2,521.4(17)	148.3(17)	85.1(17)	2.8(17)	0.11(17)	-	25.78(17)	7,085.3(17)	416.8(17)	92.0(17)	813.8(17)	47.9(17)	89.9(17)
Subtotals	42	2,962.4(42)		64.5(42)					7,700.2(42)		74.9(42)	904.7(42)		66.1(42)
Means			70.5(42)		2.6(42)	0.12(42)	0.52(21)	24.08(42)		183.3(42)			21.5(42)	
Survey Reach: 3		Survey Reach Lower Boundary:												
Reach Type: B		Survey Reach Upper Boundary:												
DPL	15	127.9(15)	8.5(15)	7.8(15)	5.7(15)	0.43(15)	0.57(15)	13.69(15)	734.3(15)	49.0(15)	28.4(15)	313.9(15)	20.9(15)	67.6(15)
LSP	1	0.7(1)	0.7(1)	0.0(1)	2.2(1)	0.20(1)	0.33(1)	11.00(1)	1.5(1)	1.5(1)	0.1(1)	0.3(1)	0.3(1)	0.1(1)
MCP	5	7.7(5)	1.5(5)	0.5(5)	1.3(5)	0.23(5)	0.35(5)	6.07(5)	10.1(5)	2.0(5)	0.4(5)	2.3(5)	0.5(5)	0.5(5)
NTU	2	131.7(2)	65.8(2)	8.1(2)	1.0(2)	0.08(2)	-	12.50(2)	131.7(2)	65.8(2)	5.1(2)	10.5(2)	5.3(2)	2.3(2)
PLP	3	8.7(3)	2.9(3)	0.5(3)	2.5(3)	0.20(3)	0.34(3)	12.21(3)	21.5(3)	7.2(3)	0.8(3)	4.4(3)	1.5(3)	0.9(3)
TUR	15	1,355.6(15)	90.4(15)	83.0(15)	1.2(15)	0.08(15)	-	16.03(15)	1,686.4(15)	112.4(15)	65.2(15)	132.9(15)	8.9(15)	28.6(15)
Subtotals	41	1,632.3(41)		35.5(41)					2,585.5(41)		25.1(41)	464.3(41)		33.9(41)
Means			39.8(41)		1.6(41)	0.18(41)	0.49(24)	15.50(41)		63.1(41)			11.3(41)	
Totals	83	4,594.7(83)		100.0(83)					10,285.7(83)		100.0(83)	1,369.0(83)		100.0(83)
Means			55.4(83)		2.2(83)	0.13(83)	0.50(45)	21.03(83)		123.9(83)			16.5(83)	

Stream ID: BC1070000
BPA Reach: 1003010310700.00
Stream Name: TENDERFOOT CR

Forest: LEWIS AND CLARK NF
District: KINGS HILL RD
Study: D91

Habitat Group	Total Number of Units	Number of Pocket Pools: Total(n)	Mean(n)	per 100 m(n)	Pkt Pool Mean Depth (m)(n)	Total Pools in STPs(n)	Average Max Depth STP Cmplx(n)	Mean Crest Depth (m)(n)	Mean Resid. Max Depth (m)(n)	Residual Volume (m³): Total(n)	Mean(n)	LWD: Total(n)	n/100m(n)
Survey Reach: 2		Survey Reach Lower Boundary:											
Reach Type: B		Survey Reach Upper Boundary:											
LSP	2	-	-	-	-	-	-	0.10(2)	0.39(2)	8.3(2)	4.2(2)	1(2)	12.0(2)
MCP	8	-	-	-	-	-	-	0.09(8)	0.38(8)	21.3(8)	2.7(8)	3(8)	16.6(8)
NTU	4	13(4)	3.3(4)	3.6(4)	0.26(3)	-	-	-	-	-	-	9(4)	2.5(4)
PLP	9	-	-	-	-	-	-	0.10(9)	0.50(9)	31.7(9)	3.5(9)	3(9)	15.3(9)
RUN	1	1(1)	1.0(1)	5.2(1)	0.20(1)	-	-	-	-	-	-	1(1)	5.2(1)
SMD	1	-	-	-	-	0(1)	0.00(1)	0.10(1)	0.43(1)	17.3(1)	17.3(1)	0(1)	0.0(1)
TUR	17	112(17)	6.6(17)	4.4(17)	0.37(16)	-	-	-	-	-	-	130(17)	5.2(17)
Subtotals	42	126(22)				0(1)				78.6(20)		147(42)	
Means			5.7(22)	4.3(22)	0.36(20)		0.00(1)	0.10(20)	0.44(20)		3.9(20)		5.0(42)
Survey Reach: 3		Survey Reach Lower Boundary:											
Reach Type: B		Survey Reach Upper Boundary:											
DPL	15	-	-	-	-	-	-	0.06(15)	0.51(15)	396.8(15)	26.5(15)	8(15)	6.3(15)
LSP	1	-	-	-	-	-	-	0.05(1)	0.28(1)	0.4(1)	0.4(1)	1(1)	142.9(1)
MCP	5	-	-	-	-	-	-	0.07(5)	0.29(5)	3.0(5)	0.6(5)	0(5)	0.0(5)
NTU	2	5(2)	2.5(2)	3.8(2)	0.26(2)	-	-	-	-	-	-	0(2)	0.0(2)
PLP	3	-	-	-	-	-	-	0.05(3)	0.29(3)	5.1(3)	1.7(3)	1(3)	11.5(3)
TUR	15	48(15)	3.2(15)	3.5(15)	0.27(11)	-	-	-	-	-	-	42(15)	3.1(15)
Subtotals	41	53(17)				-				405.3(24)		52(41)	
Means			3.1(17)	3.6(17)	0.27(13)		-	0.06(24)	0.43(24)		16.9(24)		3.2(41)
Totals	83	179(39)				0(1)				483.9(44)		199(83)	
Means			4.6(39)	4.1(39)	0.33(33)		0.00(1)	0.08(44)	0.43(44)		11.0(44)		4.3(83)

Stream ID: BC1070000

EPA Reach: 1003010310700.00

Stream Name: TENDERFOOT CR Forest: LEWIS AND CLARK NF District: KINGS HILL RD Study: D91

Habitat Group	Total Number of Units	Bank Length (m) Left(n)	Bank Length (m) Right(n)	% Stable Bank Left(n)	% Stable Bank Right(n)	% Stable Bank Mean(n)	% Unstable Bank Left(n)	% Unstable Bank Right(n)	% Unstable Bank Mean(n)	% Undercut Bank Left(n)	% Undercut Bank Right(n)	% Undercut Bank Mean(n)
Survey Reach: 2		Survey Reach Lower Boundary:										
Reach Type: B		Survey Reach Upper Boundary:										
LSP	2	10.5(2)	9.4(2)	100.00(2)	100.00(2)	100.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)
MCP	8	19.6(8)	17.2(8)	100.00(8)	100.00(8)	100.00(8)	0.00(8)	0.00(8)	0.00(8)	5.10(8)	0.00(8)	2.72(8)
NTU	4	380.1(4)	380.1(4)	100.00(4)	100.00(4)	100.00(4)	0.00(4)	0.00(4)	0.00(4)	0.00(4)	0.00(4)	0.00(4)
PLP	9	27.1(9)	23.7(9)	100.00(9)	100.00(9)	100.00(9)	0.00(9)	0.00(9)	0.00(9)	4.43(9)	0.00(9)	2.36(9)
RUN	1	21.7(1)	21.7(1)	100.00(1)	100.00(1)	100.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)
SMD	1	16.0(1)	16.0(1)	100.00(1)	100.00(1)	100.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)
TUR	17	2,689.2(17)	2,689.2(17)	100.00(17)	100.00(17)	100.00(17)	0.00(17)	0.00(17)	0.00(17)	0.00(17)	0.00(17)	0.00(17)
Subtotals	42	3,164.2(42)	3,157.3(42)									
Means				100.00(42)	100.00(42)	100.00(42)	0.00(42)	0.00(42)	0.00(42)	0.07(42)	0.00(42)	0.03(42)
Survey Reach: 3		Survey Reach Lower Boundary:										
Reach Type: B		Survey Reach Upper Boundary:										
DPL	15	153.2(15)	176.0(15)	100.00(15)	100.00(15)	100.00(15)	0.00(15)	0.00(15)	0.00(15)	26.83(15)	30.45(15)	28.77(15)
LSP	1	1.3(1)	1.3(1)	100.00(1)	100.00(1)	100.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)	0.00(1)
MCP	5	6.6(5)	7.7(5)	100.00(5)	100.00(5)	100.00(5)	0.00(5)	0.00(5)	0.00(5)	83.33(5)	51.95(5)	66.43(5)
NTU	2	140.7(2)	140.7(2)	100.00(2)	100.00(2)	100.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)	0.00(2)
PLP	3	10.7(3)	11.8(3)	100.00(3)	100.00(3)	100.00(3)	0.00(3)	0.00(3)	0.00(3)	71.03(3)	65.25(3)	68.00(3)
TUR	15	1,451.0(15)	1,451.0(15)	100.00(15)	100.00(15)	100.00(15)	0.00(15)	0.00(15)	0.00(15)	9.90(15)	11.05(15)	10.48(15)
Subtotals	41	1,763.5(41)	1,788.5(41)									
Means				100.00(41)	100.00(41)	100.00(41)	0.00(41)	0.00(41)	0.00(41)	11.22(41)	12.62(41)	11.92(41)
Totals	83	4,927.7(83)	4,945.8(83)									
Means				100.00(83)	100.00(83)	100.00(83)	0.00(83)	0.00(83)	0.00(83)	4.06(83)	4.56(83)	4.31(83)

Stream ID: BC1070000
EPA Reach: 1003010310700.00
Stream Name: TENDERFOOT CR

Forest: LEWIS AND CLARK NF

District: KINGS HILL RD

Study: D91

Habitat Group	Total Number of Units	Number of Meas. Units	Number of Est. Units	Mean Percent Substrate Coverage: Fines	Small Gravel	Gravel	Small Cobble	Cobble	Small Boulder	Boulder	Bedrock	Mean % Surface Fines
Survey Reach:2		Survey Reach Lower Boundary:										
Reach Type: B		Survey Reach Upper Boundary:										
LSP	2	-	-	-	-	-	-	-	-	-	-	4.0
MCP	8	-	-	-	-	-	-	-	-	-	-	3.5
NTU	4	-	-	-	-	-	-	-	-	-	-	-
PLP	9	-	-	-	-	-	-	-	-	-	-	5.6
RUN	1	-	-	-	-	-	-	-	-	-	-	5.0
SMD	1	-	-	-	-	-	-	-	-	-	-	-
TUR	17	-	-	-	-	-	-	-	-	-	-	6.0
Subtotals	42	-										
Means			-	-	-	-	-	-	-	-	-	4.7
Survey Reach:3		Survey Reach Lower Boundary:										
Reach Type: B		Survey Reach Upper Boundary:										
DPL	15	-	-	-	-	-	-	-	-	-	-	100.0
LSP	1	-	-	-	-	-	-	-	-	-	-	10.0
MCP	5	-	-	-	-	-	-	-	-	-	-	11.8
NTU	2	-	-	-	-	-	-	-	-	-	-	-
PLP	3	-	-	-	-	-	-	-	-	-	-	18.3
TUR	15	-	-	-	-	-	-	-	-	-	-	-
Subtotals	41	-										
Means			-	-	-	-	-	-	-	-	-	67.7
Totals	83	-										
Means			-	-	-	-	-	-	-	-	-	40.7

Stream ID: BC1070000
EPA Reach: 1003010310700.00
Stream Name: TENDERFOOT CR

Forest: LEWIS AND CLARK NF
District: KINGS HILL RD
Study: D91

Habitat Group	Total Number of Units	Single Pieces Tot#	Single Pieces Mean#	Single Pieces #/100m	Single Pieces Mean Diam.	Single Pieces Mean Length	Single Pieces Vol (m³)	Single Pieces %Sub.Vol	Aggregates Tot#	Aggregates Mean#	Aggregates #/100m	Aggregates # Pieces	Root Wads Tot#	Root Wads Mean#	Root Wads #/100m
Survey Reach:2		Survey Reach Lower Boundary:													
Reach Type: B		Survey Reach Upper Boundary:													
LSP	2	1	0.5	12.0	0.30	14.0	0.99	0.00	0	0.0	0.0	-	0	0.0	0.0
MCP	8	2	0.3	11.0	0.20	6.0	0.19	0.00	1	0.1	5.5	-	0	0.0	0.0
NTU	4	9	2.3	2.5	0.23	12.0	6.03	0.00	0	0.0	0.0	-	0	0.0	0.0
PLP	9	3	0.3	15.3	0.25	12.0	1.42	0.00	0	0.0	0.0	-	0	0.0	0.0
RUN	1	1	1.0	5.2	0.25	15.0	0.74	0.00	0	0.0	0.0	-	0	0.0	0.0
SMD	1	0	0.0	0.0	-	-	-	-	0	0.0	0.0	-	0	0.0	0.0
TUR	17	102	6.0	4.0	0.20	9.6	13.40	0.00	26	1.5	1.0	14	2	0.1	0.1
Subtotals	42	118					22.76	0.00	27			14	2		
Means			2.8	4.0	0.21	10.3				0.6	0.9			0.0	0.1
Survey Reach:3		Survey Reach Lower Boundary:													
Reach Type: B		Survey Reach Upper Boundary:													
DPL	15	8	0.5	6.3	0.24	9.9	3.95	0.00	0	0.0	0.0	-	0	0.0	0.0
LSP	1	1	1.0	142.9	0.10	6.0	0.05	0.00	0	0.0	0.0	-	0	0.0	0.0
MCP	5	0	0.0	0.0	-	-	-	-	0	0.0	0.0	-	0	0.0	0.0
NTU	2	0	0.0	0.0	-	-	-	-	0	0.0	0.0	-	0	0.0	0.0
PLP	3	1	0.3	11.5	0.25	2.0	0.10	0.00	0	0.0	0.0	-	0	0.0	0.0
TUR	15	38	2.5	2.8	0.21	8.4	15.14	0.00	3	0.2	0.2	13	1	0.1	0.1
Subtotals	41	48					19.24	0.00	3			13	1		
Means			1.2	2.9	0.22	8.4				0.1	0.2			0.0	0.1
Totals	83	166					42.00	0.00	30			27	3		
Means			2.0	3.6	0.21	9.4				0.4	0.7			0.0	0.1